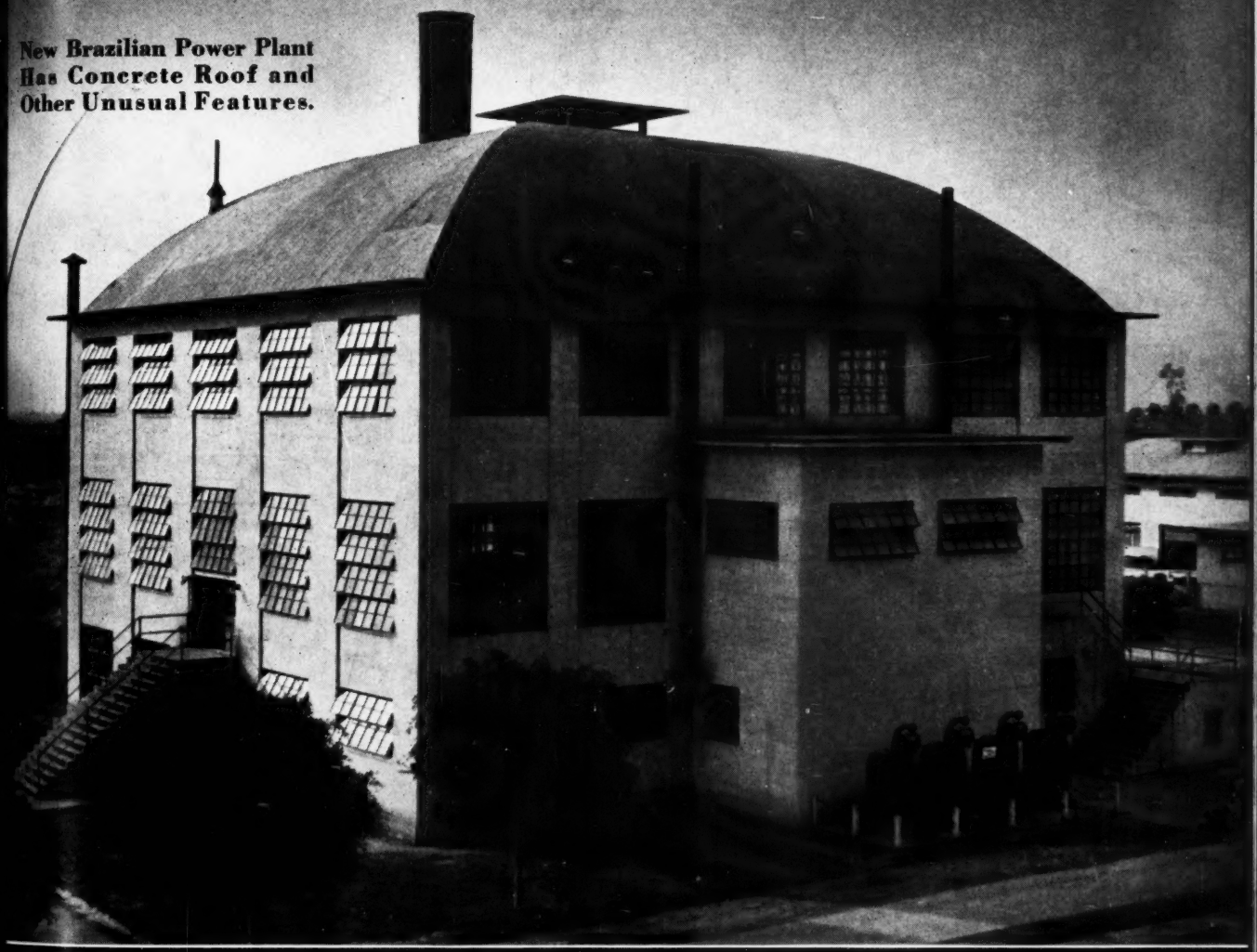
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

New Brazilian Power Plant Has Concrete Roof and Other Unusual Features.



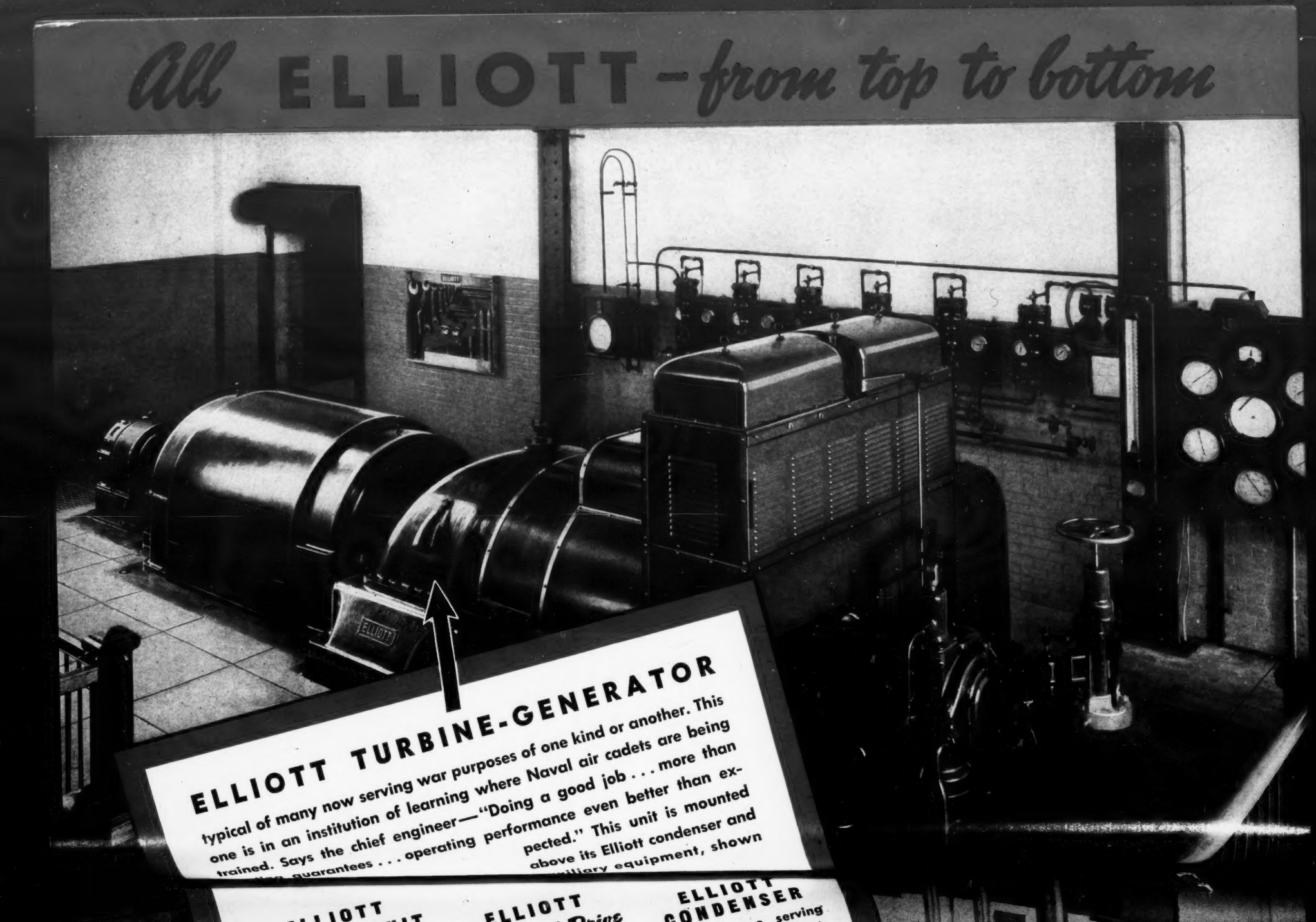
POWER FOR CEMENT CORP. IN BRAZIL

REA Plant Meets War Problems • Pumps and Packings

Machinery Maintenance • The Ignitron for DC Power

Reducing Valve Wear • Other Articles Listed on Page 5

All ELLIOTT — from top to bottom



ELLIOTT TURBINE-GENERATOR

typical of many now serving war purposes of one kind or another. This one is in an institution of learning where Naval air cadets are being trained. Says the chief engineer—"Doing a good job . . . more than [illegible] guarantees . . . operating performance even better than expected." This unit is mounted above its Elliott condenser and [illegible] auxiliary equipment, shown

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ELLIOTT

ELLIOTT CONDENSER

serving

trained. Says
above
ELLIOTT
EJECTOR UNIT
This twin two-stage steam jet ejector maintains the necessary vacuum on the condenser. Like all the related Elliott equipment in this installation, engineering and design are exactly coordinated for best overall operation and accessibility.
ELLIOTT
Mechanical Drive
TURBINE
which drives the condensate pump. Modestly trying to hide behind a pillar, but it's "all there" in reliability plus economical operation.
ELLIOTT
CONDENSER
of surface type, serving the turbine of the generating unit above. Typically Elliott in its sound design, its sturdy structure, and its efficient, dependable performance.
Other Elliott products: Feedwater Heaters and Deaerators, Motors, Centrifugal Blowers, Superchargers for Diesel Engines, Strainers, Desuperheaters Tube Cleaners.
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Diesel-powered!

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★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

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REG. T.M.

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FOR ALL DIESEL ENGINES

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

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Compression-sizing assures exceptional dimensional accuracy and uniformity. Special tools machine the ends to exact included angle.

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and true circular cross section are inherent advantages resulting from the unique manufacturing process.

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Reheating to a forging temperature normalizes both the plate and the weld, relieving the stresses set up during the forming and welding operations.

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All Midwest Elbows have tangents that facilitate the lining up and welding.

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Optional is Midwest "Long Tangent" elbow which adds 25% of the nominal pipe size to the center-to-end dimension of the American Standard Elbow at no increase in price.

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MIDWEST WELDING FITTINGS SAVE TIME, IMPROVE THE DESIGN, AND REDUCE THE COST OF PIPING SYSTEMS

FRONT LINES

POWER line carrier current, once regarded as merely an ingenious electronic novelty, has become in 20 yr. a vital means of communication and control for the power industry and promises an increasingly important role in America's war effort. Four of the most important jobs performed by carrier current on high voltage power lines are telephoning, relaying, telemetering, including automatic load control, and supervisory control. The General Electric Co. made the first commercial power line carrier installation in Utica, N. Y., in 1922.

A NEW insulating material for electrical wiring that completely eliminates tin and rubber and leaves only the copper conductor to be made of a vital material is now ready for general distribution, according to I. A. Bennett of National Electric Products Corp. For years wire of this type has been coated with tin and wrapped in rubber, requiring comparatively large quantities of both these materials. But shortly after Pearl Harbor, research was begun to solve this problem. The new insulating material, together with a specially treated paper, was developed and has been given very thorough testing.

IGNITRONS Invade Mines in Colorado, says a Westinghouse Editorial Service headline. However, they are not expected to put the tommyknockers out of business. Turn to page 76 of this issue if you are curious to know about the Ignitrons. Mining men can tell you all about the tommyknockers but the ignitrons will be new ones to them.

THE first allotment of steel, copper and aluminum under CMP was made on schedule during the first week of February to the fourteen claimant agencies for delivery to war producers during the second quarter of this year. "Full provision has been made in the allotment for the must programs—synthetic rubber, high octane gasoline, aviation, army material, merchant and naval shipping and escort vessels—as they currently stand," said WPB Chairman Nelson. "Less essential programs have been cut to the bone." The materials included 17,000,000 t. of steel products, of which some 15,000,000 t. was carbon steel and some 2,000,000 t. alloy steel, about 600,000 t. of copper and about 600,000,000 lb. of aluminum.

INDUSTRIAL fuel oil refined in parts of certain states was subjected last week to a new price structure and a new schedule of dollar and cent ceilings devised by OPA and PAW. The new schedule will make more industrial fuel oil available in the areas by encouraging the blending of low gravity and the cheaper residual oils with the higher gravity, more costly distillate fuels. It will also equalize prices, meet increasing wartime demands of railroads and industries by augmenting local supplies and eliminating uneconomic transportation and also release oil tanks for hauling fuel to eastern customers.

WORK is scheduled to start in March on a second big oil pipeline to the East Coast. This 836-mi., 20-in. conduit to be built for the Government by War Emergency Pipelines, Inc., at a cost of about $44,000,000 is designed to deliver 235,000 bbl. a day of petroleum products from Texas to tank carloading points in Illinois and Indiana. It is expected that the line can be completed on or about September 1.

SCORES of laundries, some large enough to care for the weekly washing of thousands of men and others small enough to be moved about behind battle lines, are being operated by the Army Quartermaster Corps. The portable laundries for operation behind battle lines are mounted on trucks and contain machinery necessary to do a day's washing. The water systems are hooked up with a convenient creek or river. Of course, there are no facilities for ironing these battle-field-washed clothes but the soldiers' desire for fresh clothing is making these mobile units highly popular.

HEARD the one about the snail and the cherry tree, asks Printer's Ink? It seems there was once a snail that started to climb a cherry tree one raw, cold morning in January. As he inched painfully upward, a wise-guy beetle stuck his head out of a nearby crack and said, "Hey, buddy, you're wasting your strength. There ain't any cherries up there." But the snail kept right at it. "There will be when I get there," he said.

THIS is a fine time to have to shut down that 500-kw. turbine generator, isn't it? But it shows a fluctuating resistance to ground and it may fail any time. Not much doubt that it needs rewinding. The worst part of that is not the rewinding but the outage. But before you bet any money on it, just listen to this: A 500-kw. turbine generator was recently sent back to the Westinghouse shops for rewinding because it had developed the fault mentioned above. Before beginning work a careful analysis was made and the trouble was located; a small metal shaving in the coupling end lead was found and removed. This brought the insulation resistance from 0.6 megohm to 200 megohms, a satisfactory value. The machine was back in service again in a few days.

SPEAKING of the gremlins and tommyknockers reminds us that some work needs to be done in investigating and inhibiting the work of the little people in the power plant business, often called thermogloops by engineers. These are entirely different from the tommyknockers, whose activities are usually more beneficial than otherwise. The gremlins, too, are not always evil, according to the flying men. The thermogloops are the little people that bore holes below the surface of castings, that wedge pieces of scale or of somebody's overalls into valves so that they won't close, that get into boiler tubes and scatter pieces of copper about, thereby starting harmful electrolytic action. These thermogloops may be related to the gummyfressers who inhabit drafting rooms and subsist on a diet of erasers. The thermogloops have one especially bad trick. When you are looking up a value of enthalpy in the steam tables, you often lay a straight edge across the table so that you will be sure to stay in the correct column. Now during the extremely short time it takes you to look for and pick up a pencil and look back at the table again, the thermogloops very skillfully move the straight edge down one line. No wonder people get wrong answers.

THE function of the expediter is being tremendously stimulated by the war. We had him, of course, in time of peace but now his function is primarily to keep supply lines moving. As Andrew H. Phelps, head of the Westinghouse expediters explains it, that often means going to the supplier's supplier or even farther down the supply ladder to break a bottleneck or free the key log that is causing a material jam. Mr. Phelps, a sales executive for 18 yr., thinks the best type of expediter must have the qualifications of a salesman—confidence, enthusiasm, diplomacy, resourcefulness and good-will. Expediting, he says, is a very high form of selling, without high pressure.

CONTROLLED Materials Plan Regulation No. 1, defining the rights and obligations of industry under CMP, has just been issued. This basic regulation deals specifically with methods of applying for, receiving and making allotments. CMP Regulation No. 2, issued January 7, provides control over manufacturers' inventories of the controlled materials, aluminum, copper and steel. Other CMP Regulations now in preparation will cover such phases of the program as the place of preference ratings in CMP, maintenance, repair and operating supplies, construction and facilities, warehouses and other distributors, and reports.

THERE are still considerable quantities of manila rope in the country and the government wants to buy all excess in the hands of business concerns and other owners. These holders are asked to report voluntarily all manila rope they can spare if it is 3/16 in. or more in diameter, and 200 ft. or more in length. The government will pay 10 per cent above the owner's net cost exclusive of freight charges. Owners are requested to communicate at once with Murray Cook, 155 E. 44th St., New York City, who will arrange for purchases, acting as agent for the government.

YOU can, perhaps, have skilled employes deferred from the draft if you are engaged in heating, power and water supply or illuminating industries, says The United States News. Note that 'perhaps'. Better check up with the local Selective Service Board.

DON'T look now—but have you noticed how many advertisements these days in all sorts of publications are giving you real information about how you can make the best use of the equipment you have and how you can do best the things you have to do with what you can get? For years and years and years, engineers have been asking us why advertisers didn't put more real information into their advertisements. They are now being forced by the war to do the very thing that gains them the most attention from the people they want to read their advertisements.

THE science of refining has become so flexible that it can produce nearly anything for which there is a need. For example, while we are extracting from our petroleum the raw material for making rubber, the Japanese, temporarily in possession of large resources of rubber in the Dutch Indies, but without sufficient resources of petroleum, have developed a process by which they can make gasoline from rubber as the raw material. The Sinclair Firebox, December, 1942, shows some interesting diagrams of a number of the variations of the petroleum refining process.

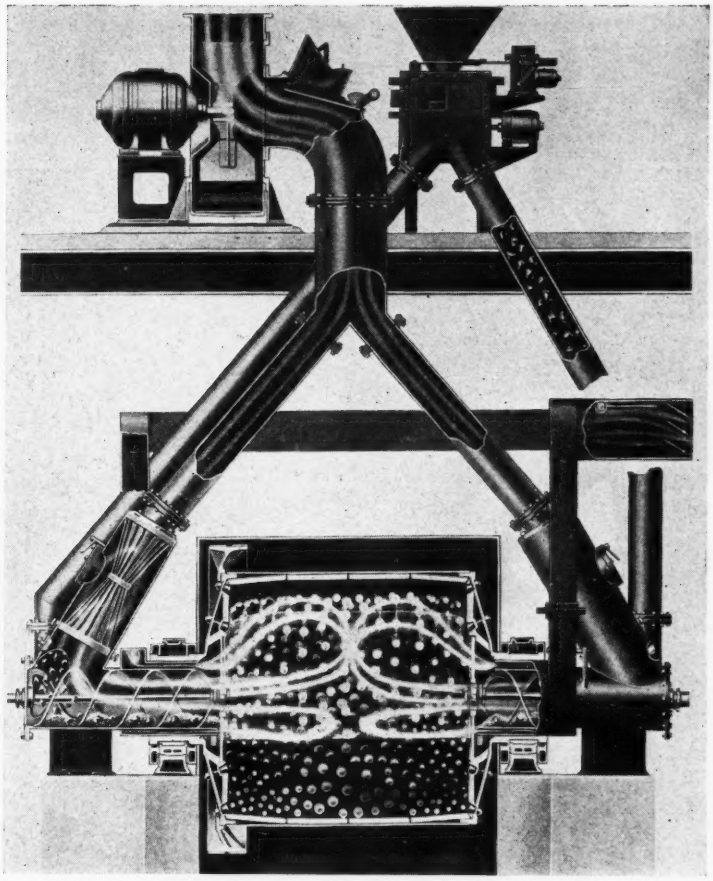
A Study of Chert as a Deleterious Constituent in Aggregates has just been issued by a famous laboratory. Of course, you are much interested in Chert but somehow that title sounds to us like double-talk. It reminds us of the scene in the motion picture "Desperate Journey" where Johnny, a captured American flyer, is being questioned by a Nazi officer about the workings of the G. E. airplane supercharger at high altitudes. "If I told you—the others wouldn't know?" asks Johnny, the prisoner, played by Ronald Reagan. "Certainly not," says the German. Johnny casts a glance at the closed door, lowers his voice so that the Nazi leans forward. "It's done with a thermotrockle," says Johnny. "With a what?" asks the Nazi. "A thermotrockle amfilated through a daligonitor," continues Johnny, beginning to sketch with his left hand. "You see, the dornadyne has a frenicoupling and the amsometer prenulates the kinutaspel hepulace—here—and the—" The Nazi, now off his guard, is then neatly slugged by Johnny.

THE integral power plant for airplanes is something that can't be done, some people say, and even if it could, it isn't worth while. But Sanford A. Moss, before the recent S.A.E. meeting, described such a plant in detail and argued that it was very much worth while for the aviation industry to consider and probably for the automobile industry as well. By an integral power plant he means an assembly of engines, turbo-superchargers, generators, propellers and all accessories designed for a desired overall performance, to be installed ahead of the fire wall in the front section of the nacelle of an airplane. Both the Germans and the English have done some work on these integral power plants but so far, says Mr. Moss, there has been only a lot of vague talk in the United States about it. He thinks there should be much more than talk, and discusses the advantages of having such a plan carried out by a specialized group. Such specialization, he says, already has come about in the design of steam power plants, where specialists design and erect an entire power plant, including boilers, engines and all accessories.

EKA-IODINE, the last of the 92 elements classified and tabulated in 1869 by Mendeleeff, has recently been isolated in Switzerland by Dr. Minder of Bern's Radium Institute and Dr. Alice Leigh-Smith, British student of the late Mme. Curie. In a burst of international patriotism, they named the new element anglohelvetium after their native lands as Mme. Curie named polonium for Poland. This name, however, may not be final for the ending implies a metal, whereas the new element is decidedly non-metallic. Furthermore, discovery of the new element has been previously claimed elsewhere. In 1931, Dr. Fred Allison and his collaborators at Alabama Polytechnic Institute isolated what they believed was a small amount of eka-iodine. They named it alabamine. The anglohelvetian stars, says Time, unable to resist this one, may merely have fallen on alabamine.

SAYS Leon S. Lyon of Portland, Oregon, "In passing through one of the yard offices of the Kaiser Shipyards in this district I saw a sign reading as follows: 'The difficult we do immediately—the impossible takes a little longer.'"

Wartime Duty



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SAVE COAL

High fineness can be continuously maintained independent of wear *while mill is in service.* Lower carbon loss, more accurate combustion control, and less coal per lb. of steam combine for higher efficiency.

SAVE LABOR

Low speed, rugged construction, and simplicity of design insure least maintenance.

SAVE TIME

Operating records while steam generating units are in service show availability of 98-100%, thus minimizing boiler outages attributable to pulverizer failure.

The Army-Navy Production "E" with star has been awarded to Foster Wheeler in recognition of quality equipment, in quantity, on time.

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"Our Natural Selection

View of the Boiler Room of the R. K. LeBlond Machine Tool Co. showing the 3 Yarway Seatless Tandem Blow-Off Valves on boiler mud drums.

YARWAY

...vas
YARWAY SEATLESS TANDEMS"

(Says R. K. LeBlond Machine Tool Co.)

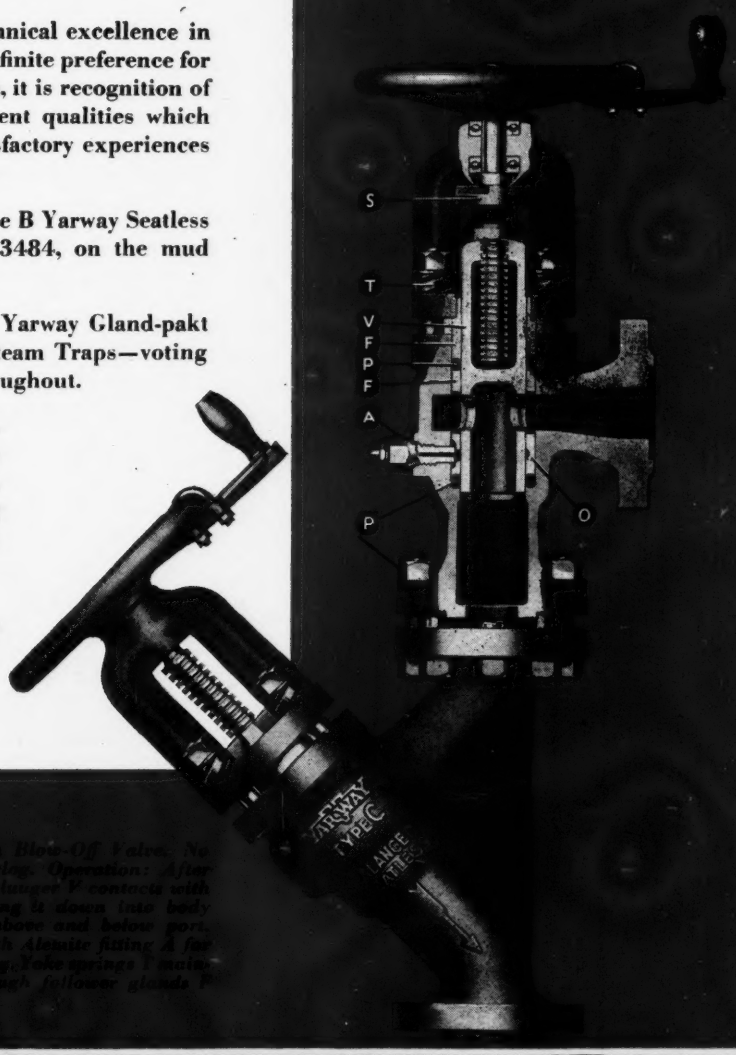
WHEN a firm so well known for mechanical excellence in their own products expresses such definite preference for the Yarway Seatless Blow-Off Valve design, it is recognition of sound valve engineering—of those inherent qualities which have been responsible for the highly satisfactory experiences of more than 12,000 Yarway Valve users.

This installation comprises six 2½" Type B Yarway Seatless Valves used in tandem, Fig. Nos. 3482-3484, on the mud drums of three 160-lb pressure boilers.

This Cincinnati plant is also a user of Yarway Gland-pakt Expansion Joints and Yarway Impulse Steam Traps—voting a "straight ticket" for Yarway quality throughout.

Whatever your Blow-Off Valve requirements, there is a Yarway Valve specifically designed for the pressure, purse and purpose. Write for Catalog. Section B-422 for pressures up to 400 lb; section B-431 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
114 Mermaid Ave. Philadelphia



The Yarway Seatless Tandem Blow-Off Valve. No seat to score, wear, leak or clog. Operation: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packing P, above and below port. Annular groove O connects with Alemite fitting A for lubricating plunger and packing. Yoke springs T maintain continuous pressure through follower glands F on packing rings P.

BLOW-OFF VALVES

An Engineer's View— of freedom from trap troubles!

DEPENDABLE performance — that's what an engineer looks for in a steam trap. Thousands of Armstrong traps being used in the oil industry are proving the advantages of their rugged simple design in providing efficient, trouble-free service. Here are a few Armstrong features translated into what they mean in freedom from trap troubles:

1. **"FREE FLOATING" VALVE** — *no binding or sticking . . . opens wide . . . positive action.*

2. **SELF-SCRUBBING ACTION** — *swirling water carries all ordinary dirt and scale right on through.*

3. **AUTOMATIC AIR ELIMINATION** — *a vent removes air from the system and discharges it with condensate.*

4. **LONG LIFE PARTS** — *mechanism made of special alloys reinforced at points of wear . . . chrome steel valve and seat.*

Armstrong traps are available in a wide range of side inlet and bottom inlet styles for virtually every condensate drainage job. Write for catalog.

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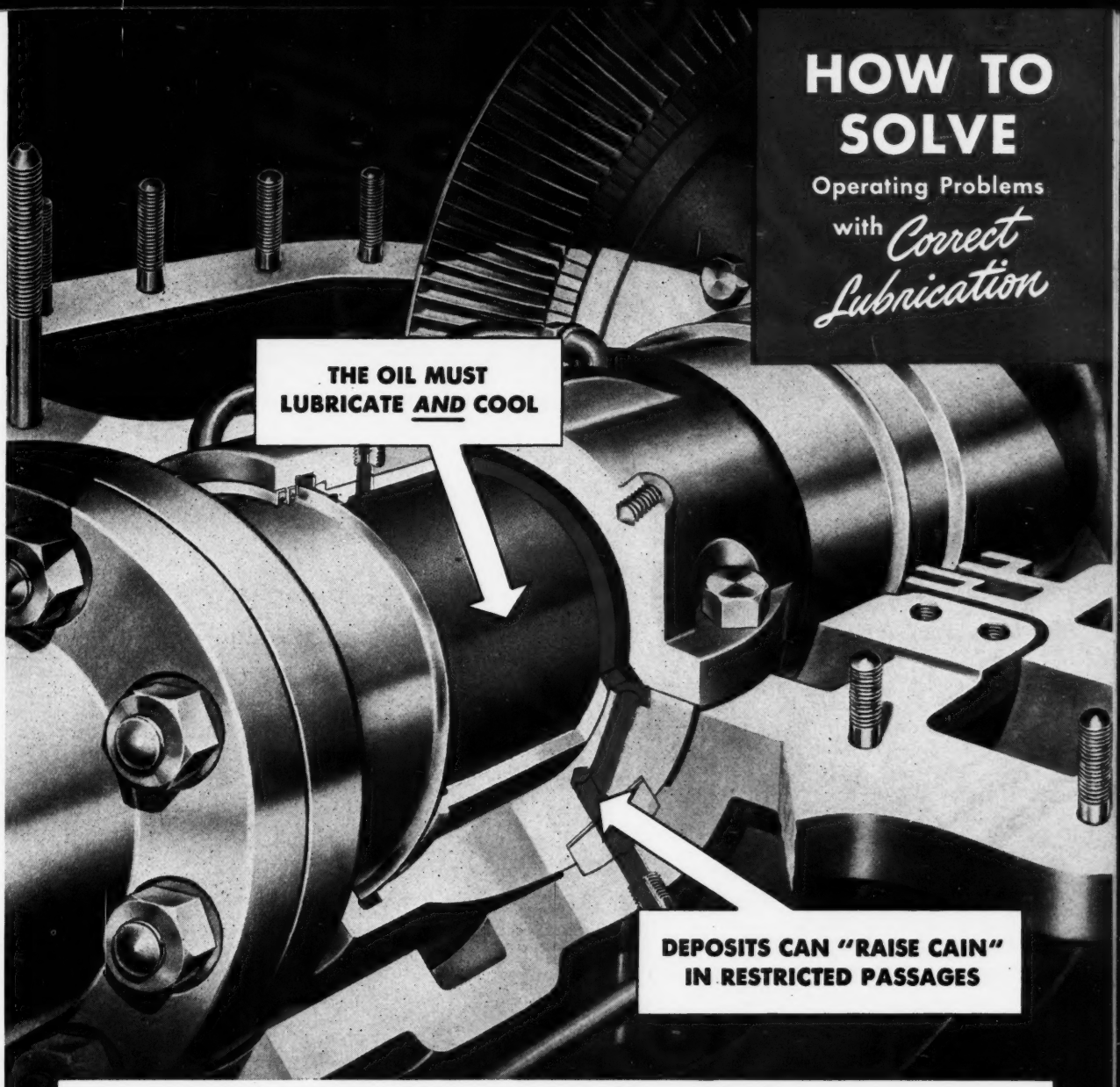
ARMSTRONG INVERTED BUCKET STEAM TRAP

ARMSTRONG STEAM TRAPS

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION


HOW TO SOLVE
Operating Problems with Correct Lubrication
THE OIL MUST LUBRICATE AND COOL
DEPOSITS CAN "RAISE CAIN" IN RESTRICTED PASSAGES

Use "Character" Analysis!

PROBLEM: Selecting turbine oil is a major decision. For only an oil film stands between safe operation and possible destruction of the turbine. The oil must maintain a high chemical stability over a long period of service, because deposits resulting from oil oxidation may interfere with free oil flow through the bearing and governing apparatus. This will cause higher operating temperatures, rapid oxidation, even disastrous bearing failure.

ANSWER: The most dependable way to foretell what a turbine oil will do is to analyze its character. *What has it done for others over a long period?* Gargoyle D. T. E.'s are used in over 50% of U. S. A.'s major-sized turbines and have service records of over 120,000 hours in a single turbine. It has been *proved* that their chemical stability assures trouble-free lubrication. These oils are far-and-away your wisest and safest choice.

GARGOYLE Lubricants

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CALL IN SOCONY-VACUUM

this information will help

1 Those who face the problem of making their present stokers last for the duration.

2 Those who have recently installed stokers and wish to become more familiar with the fundamentals of operation and maintenance.

3 Those who are planning to convert to stoker firing.

"Fundamentals of Stoker Operation and Maintenance" should prove helpful regardless of what stoker you have or may install because it covers all types—

Single Retort Underfeed
Multiple Retort Underfeed
Chain and Traveling Grates
Spreader

While the information is based on experience with the various types of C-E Stokers, the fact that it deals with the fundamentals of operation makes it generally applicable to all types, regardless of manufacturer.

Having the most complete line of stoker equipment on the market, and the experience gained in the manufacture and installation of more than 17,000 stokers of all types, Combustion Engineering is especially qualified to provide competent advice and assistance to stoker users.

Today, as never before, it is vitally important—really a patriotic duty—that equipment be maintained at the peak of its output and efficiency. This, added to the difficulties often encountered in obtaining repair parts, emphasizes the necessity of competent operation, regular inspection and adequate maintenance.

The collected information in this booklet is designed to help you to achieve these objectives. Write for your copy. No obligation, of course.

If you are contemplating conversion from oil to coal, you will be interested in the pamphlet "Factors Governing Conversion from Oil to Coal Firing." It is a very practical discussion of the question built around several actual case studies. We shall be glad to send a copy upon request.

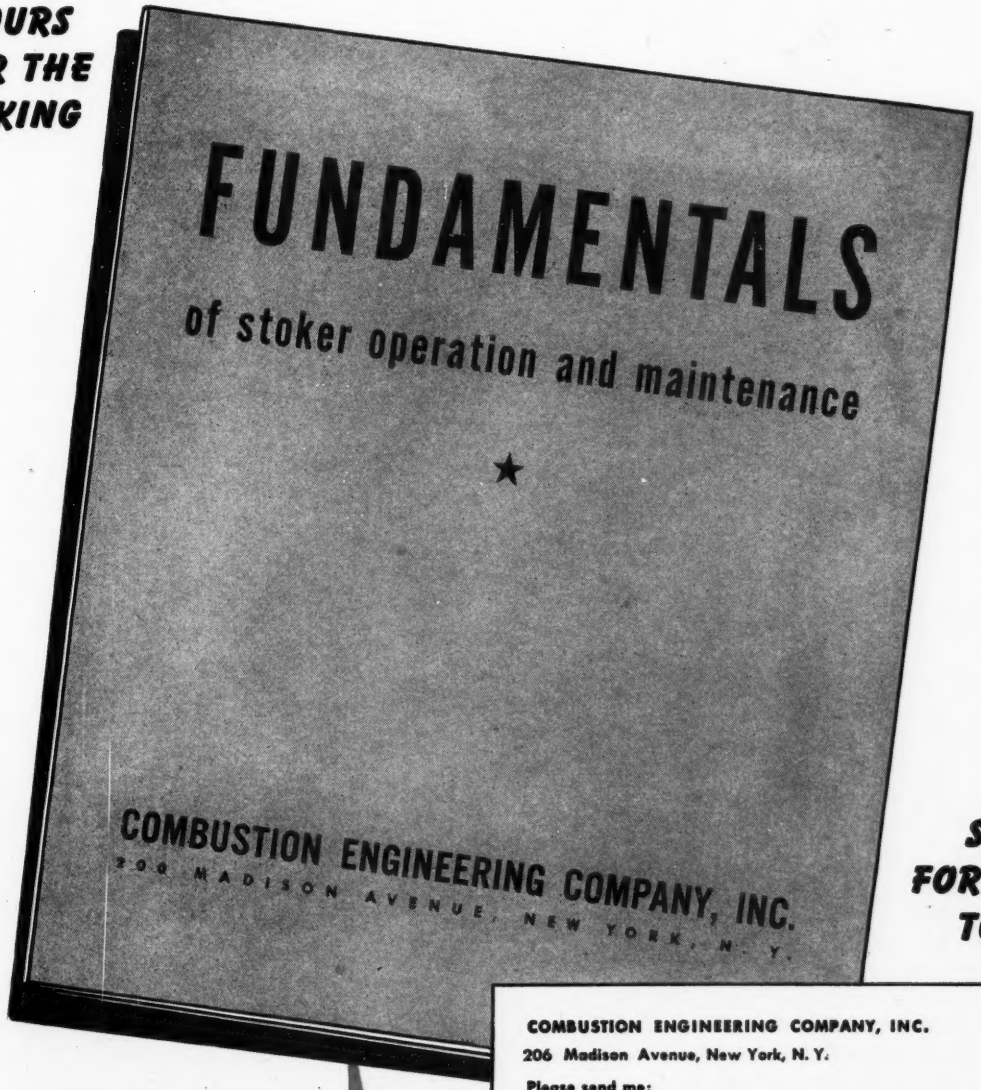
A-712

COMBUSTION ENGINEERING

206 MADISON AVENUE, NEW YORK, N. Y.

3 groups of STOKER users

YOURS FOR THE ASKING



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206 Madison Avenue, New York, N. Y.

Please send me:

☐ **"Fundamentals of stoker operation and maintenance"**
☐ **"Factors governing conversion from oil to coal firing"**

NAME.....

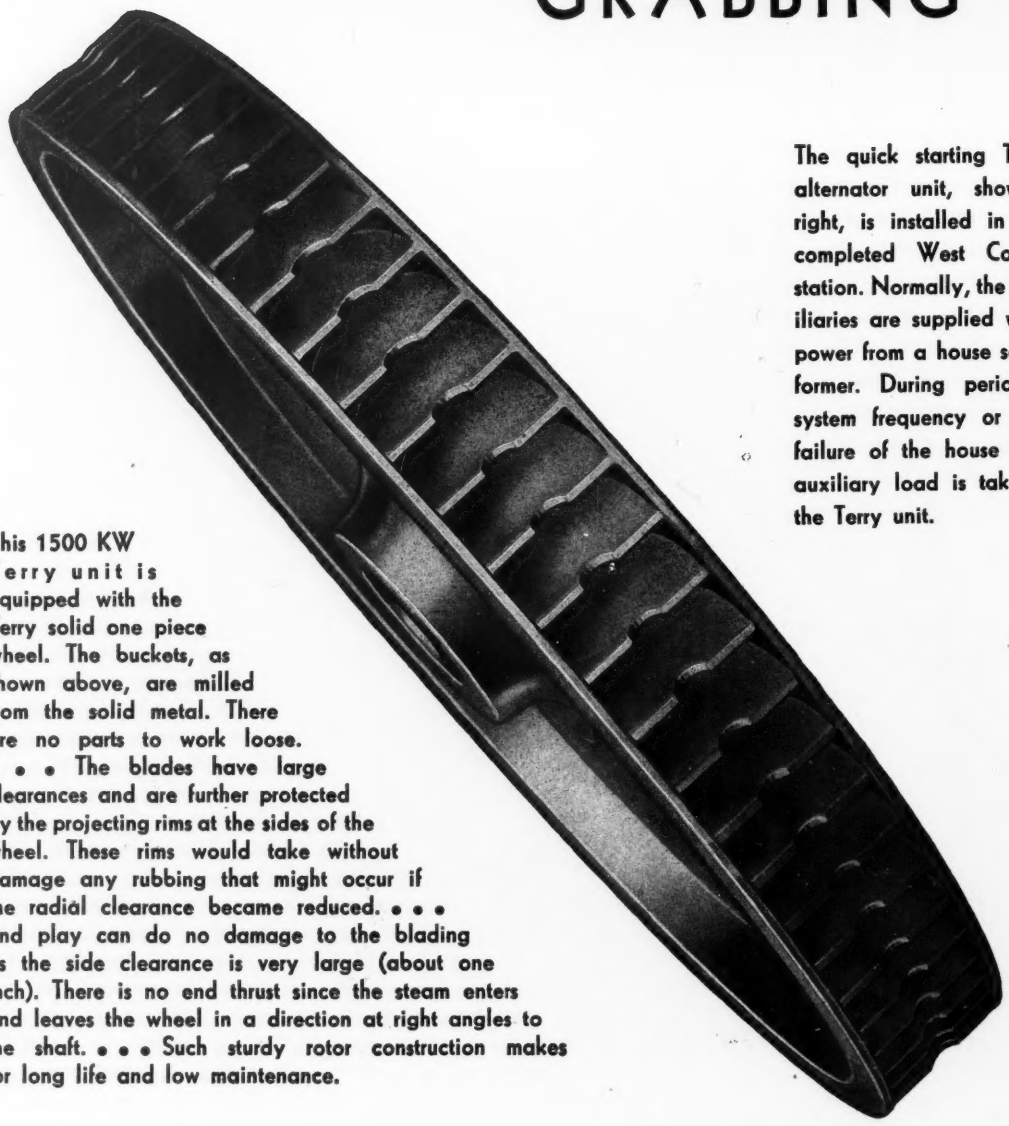
COMPANY.....

ADDRESS.....

CITY..... **STATE**.....

The TERRY

GRABBING A 1



This 1500 KW Terry unit is equipped with the Terry solid one piece wheel. The buckets, as shown above, are milled from the solid metal. There are no parts to work loose. • • • The blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced. • • • End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft. • • • Such sturdy rotor construction makes for long life and low maintenance.

The quick starting Terry turb[ine] alternator unit, shown at t[he] right, is installed in a recent[ly] completed West Coast centr[al] station. Normally, the station au[x]iliaries are supplied with electr[ic] power from a house service tra[ns]former. During periods of l[ow] system frequency or in case [of] failure of the house service, t[he] auxiliary load is taken over b[y] the Terry unit.

THE TERRY STEAM TURBINE CO.

Wheel Turbine

A 1500 KW LOAD ON A MOMENT'S NOTICE!

rry turb e unit is ready to take over on
n at t moment's notice. It operates
a recent ith steam at 625 lbs. 825°F. T.T.,
st cent nd comes up to full speed and
ation au pacity in a matter of seconds
th elect a strenuous task, with extra
vice tra ads on blading, rotor, bearings,
s of l nd governor.
n case etails of this rugged turbine are
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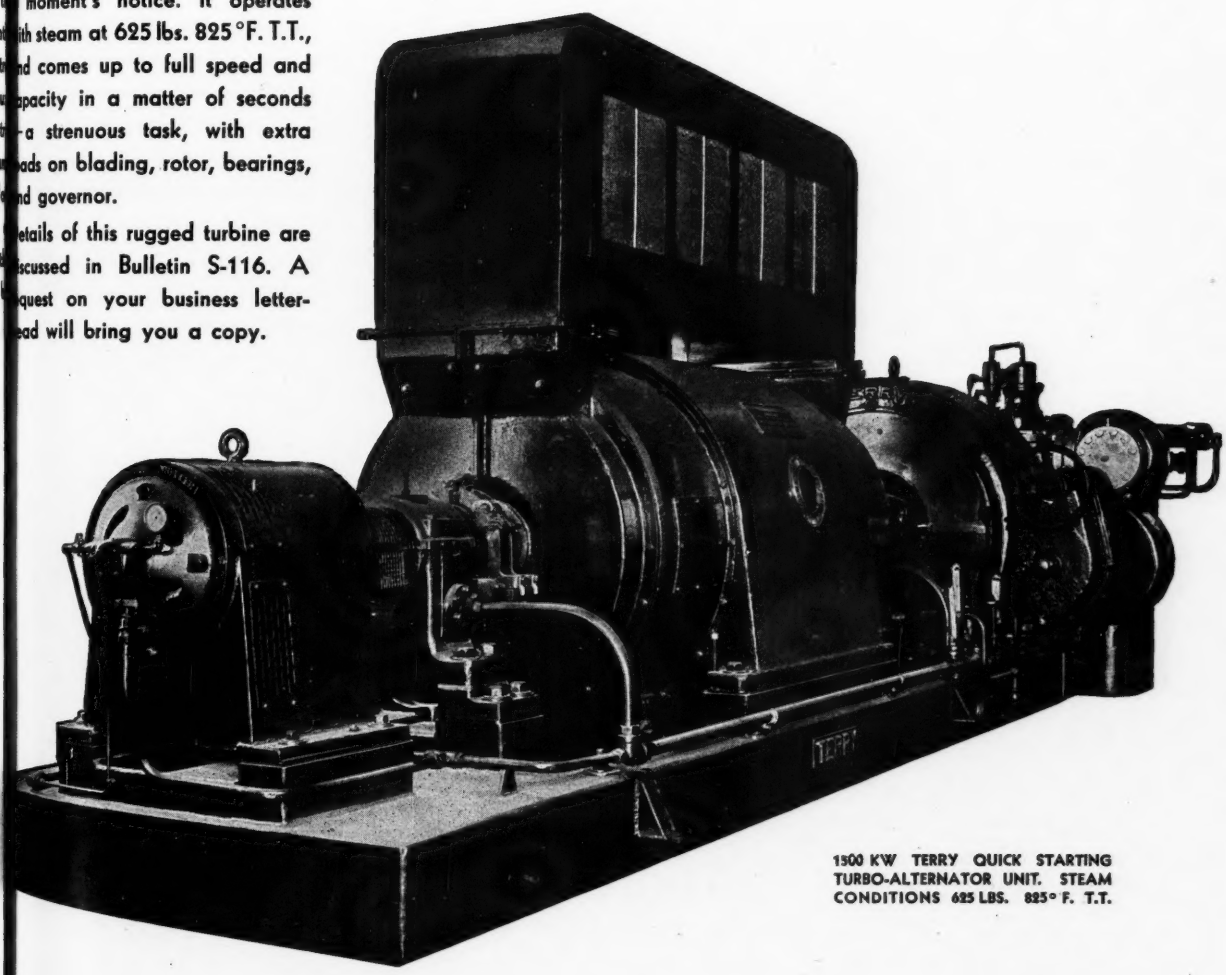


1500 KW TERRY QUICK STARTING TURBO-ALTERNATOR UNIT. STEAM CONDITIONS 625 LBS. 825° F. T.T.

T-1150

TERRY SQUARE - HARTFORD, CONN.

ARSENAL INSTALLED A
...MORE POWER TO T

PROBLEM:

In 1937 and again in 1939, a large arsenal located in Eastern United States faced the problem of installing fuel firing equipment most suitable to their current as well as future emergency needs—needs of peacetime, war preparation, or all-out war production. Reliability was paramount. The nature of the operations required wide steaming fluctuation—with great variation in the quantity of steam demand. Capacity must be sufficient to maintain operation while boilers were out for inspection, or in case of failure of a unit it must be prepared to go on 24 hour duty. And because of location, it must discharge a minimum of fly ash.

SOLUTION:

In each year, A-E-CO Taylor Stokers were purchased by the arsenal. Two were installed in 1937; another two in 1939. All four A-E-CO Taylor Stokers are 7 retort, 37 tuyere, continuous ash discharge type, driven by steam turbines.

RESULTS:

In a subsequent report on operating performance, covering precisely one year, the arsenal generated 547,651,000 lbs. steam, burning 55,949,000 lbs. coal (Average evaporation 9.8 lbs. steam/lb. coal). Operating conditions: 450 lbs. pressure, gauge; 620°F. steam temperature; and 215°F. feed water temperature to boiler. The combined efficiency was 79.1% *without* the use of any heat recovery equipment. There have been no complaints about stack discharge although the arsenal now works 24 hours a day.

CONCLUSION:

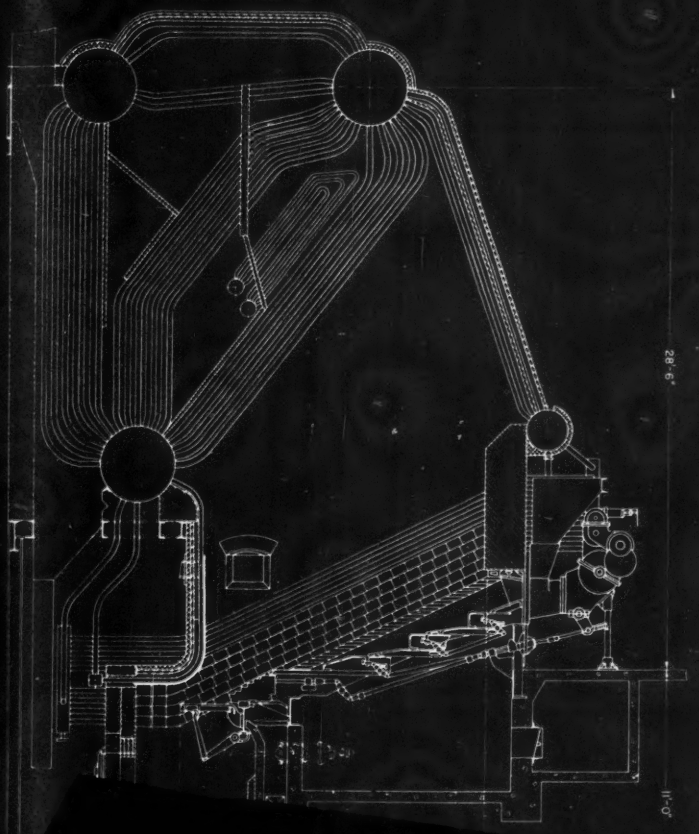
When there is any possibility that steam demands may be suddenly varied without warning—and remain under changed conditions indefinitely—when stack discharge is a matter of concern to your community, when reliability, capacity, and wide steaming fluctuations may have to be met, look carefully into the advantages of A-E-CO Taylor Stokers before you make your choice.

A CASE IN THE GOVERNMENT PLANT FIELD

AMERICAN ENGINEERING

PHILADELPHIA . . PENNSYLVANIA

D A·E·CO TAYLOR STOKERS
O THE WAR EFFORT



A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America #1
*Aluminum Company of America #2
American Tobacco Co., Inc., Durham, N. C.
Castanea Paper Company
Chrysler Corporation, DeSoto Plant
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
*Consolidated Paper Company
*Cresson State Sanitarium, Cresson, Penna.
Defiance Milk Products Co., Defiance, Ohio
*DeLaval Steam Turbine Co.
*Detroit Sulphite Pulp & Paper Co.
City of Dover, Ohio
*Draper Corporation
Erwin Cotton Mills Co.
*Fisher Body Corporation #1
Fisher Body Corporation #2
*Fisher Body Corporation #3
*Fisher Body Corporation #4
Fox Paper Company
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Galion, Ohio
*Gardner-Richardson Company
*General Electric Company #1
*General Electric Company #2
*Greenwood Electric L. & W. Plant
*Board Public Works, Hannibal, Mo.
Hill School, Pottstown, Penna.
*Holsert Mfg. Co.
*City of Holland, Michigan
*Hope Natural Gas Co.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company
Maryland State Penal Farm, Roxbury, Md.
*Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills
*Packard Motor Car Co.
*Municipal Electric Plant, Painesville, Ohio
*Park Drop Forge
*Pennsylvania Electric Co.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Pittsburgh Plate Glass Co.
Borough of Quakertown, Quakertown, Penna.
Raleigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sayles Bilmore Bleachery, Biltmore, N. C.
Scotten Dillon Company
Shelby Cotton Mills
Sloane-Blabon Corp.
*Solvay Process Company
*St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co. #1
Timken Roller Bearing Co. #2
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
*Borough of Vineland, New Jersey
Warfield Natural Gas Company, Harold, Kentucky
White Sewing Machine Co.
Whiting Plover Paper Company

(*) Represents repeat orders.

A-E-CO TAYLOR STOKER

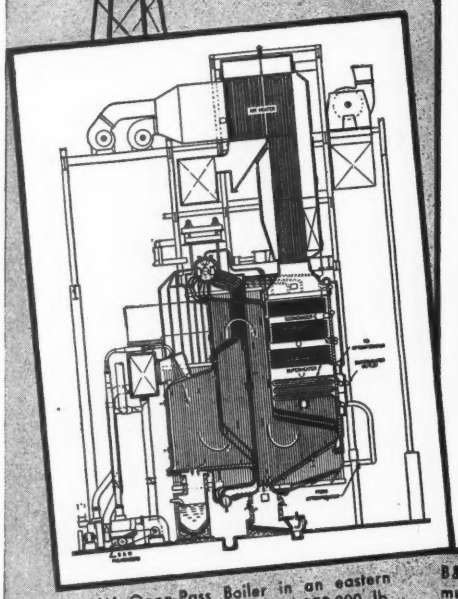
A-E-CO TAYLOR STOKERS
WATER WALLS-ASH HOPPERS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

CO COMPANY

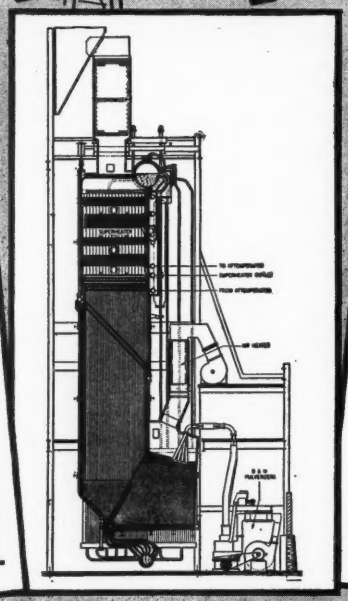
ARE YOU JUDGING YOUR STOKER BY THESE TWELVE POINTS?

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

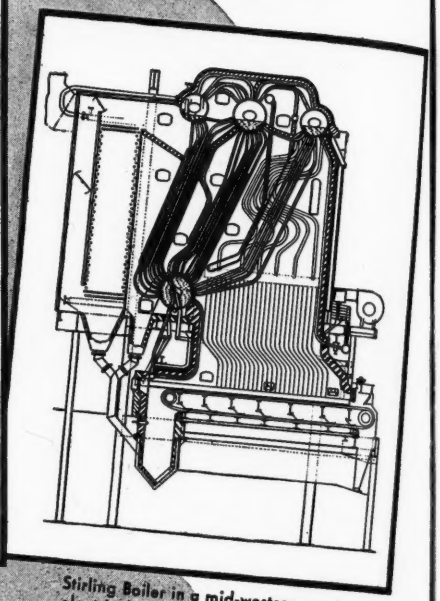
Helping



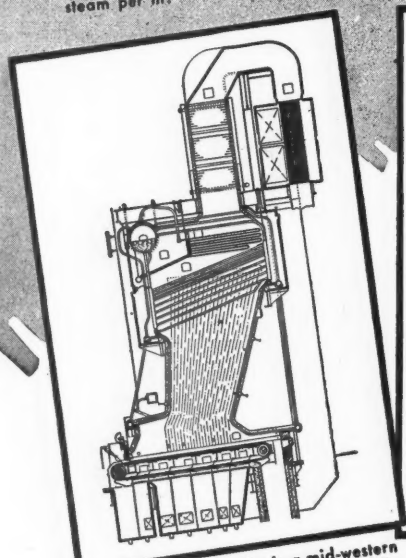
B&W Open-Pass Boiler in an eastern central station — Capacity 350,000 lb. steam per hr.



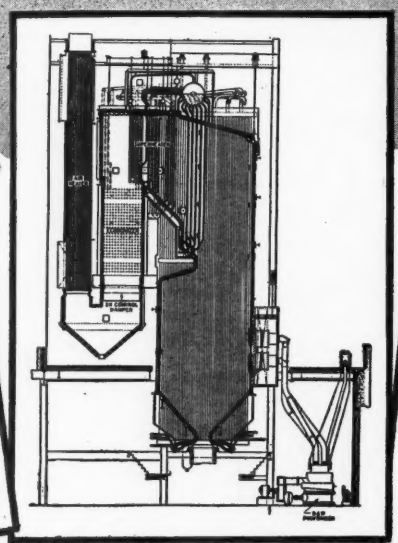
B&W High-Head Boiler in a mid-western municipal electric light plant—Capacity 300,000 lb. steam per hr.



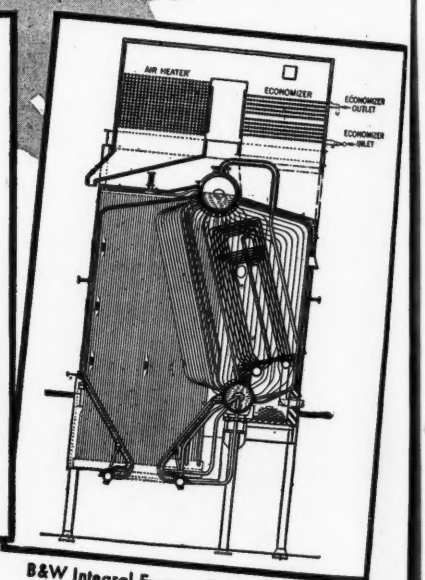
Stirling Boiler in a mid-western municipal electric light plant — Capacity 125,000 lb. steam per hr.



B&W Cross-Drum Boiler in a mid-western central station — Capacity 180,000 lb. steam per hr.

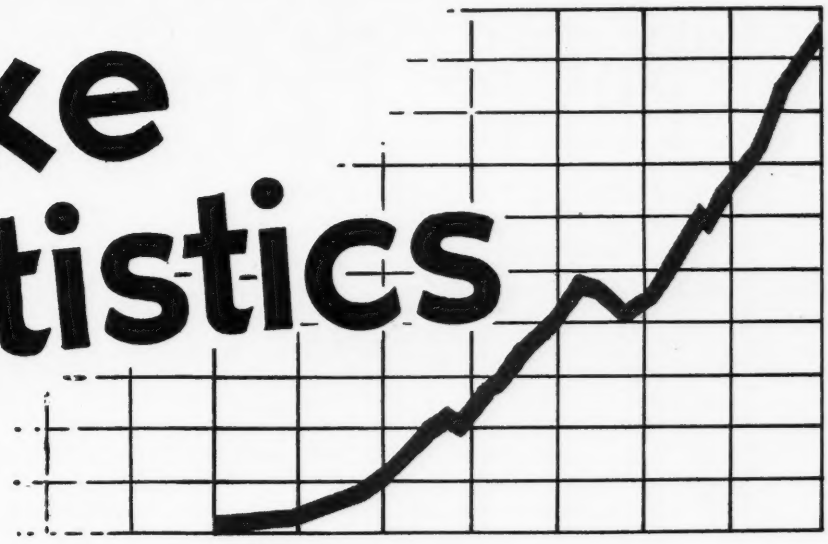


B&W Radiant Boiler for a southern central station—Capacity 400,000 lb. steam per hr.



B&W Integral-Furnace Boiler for an eastern central station — Capacity 150,000 lb. steam per hr.

Make Statistics

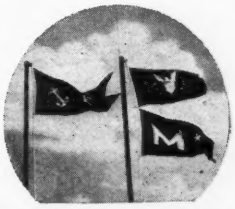


Statistical peaks in war-time power production have been made possible in no small degree by boilers built by B&W. The Open-Pass, Radiant, High-Head, and Integral-Furnace Boilers, the more recent of B&W's designs, have definitely established their ability to supply large blocks of power reliably. Standard B&W Cross-Drum and Stirling boilers need only passing mention as statistics makers—they have made records in their fields for many decades.

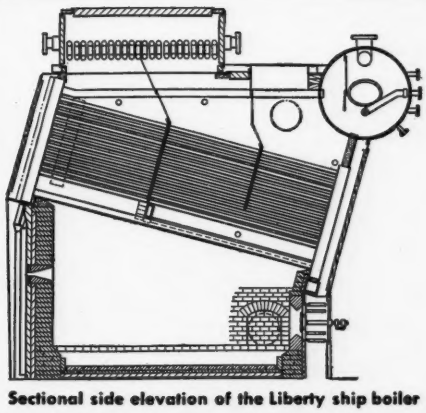
Noteworthy as is the production of steam for industrial power by B&W boilers, the records made in the marine field by other B&W boilers are equally impressive—whether in naval or other government service, or in the merchant marine. Statistics of ships placed in service might well be interpreted in terms of additional B&W boilers gone to sea, since B&W builds the greatest proportion of marine boilers. And one of B&W's designs was chosen by the Maritime Commission for all of its Liberty Ships, and all manufacturers of Liberty Ship boilers are working to B&W drawings.

So, whenever statistics on steam-power production appear, in the background are B&W boilers helping make the statistics possible. And, after the war, when materials for boilers for general service are again freely obtainable, B&W boilers with inherent richer experience will be available.

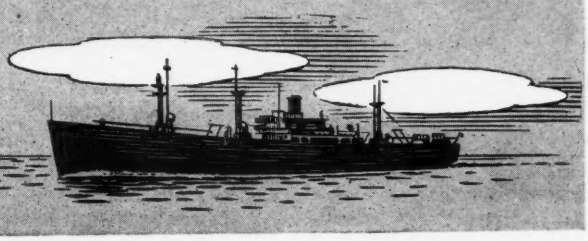
G-241T



The Maritime Victory flag and "M" burgee now float proudly alongside the Navy "E" at the Barberton Works. Each is an award for "outstanding achievement" and is "an honor not lightly bestowed".



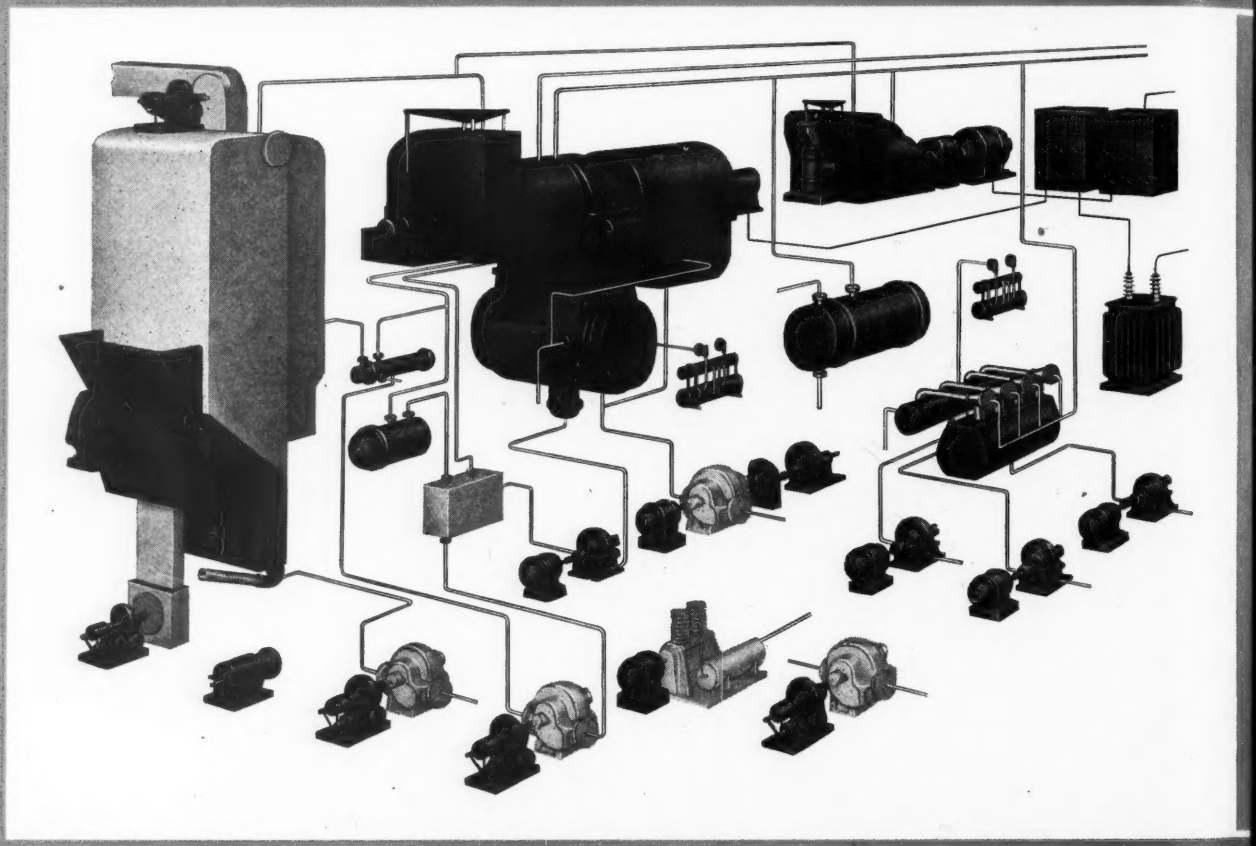
Sectional side elevation of the Liberty ship boiler



BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK, N. Y.

"Power Plant Auxiliaries?



for your equipment library...

Copies of any of these publications will be sent to you on request. You'll find them useful, factual—worth-while additions to your library of information on power equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

- B-2230-A—TYPE C TURBINES, standard single-stage and 2-stage turbines, from 5 to 1500 hp capacity, for all mechanical drive applications.
- B-3012—TYPE CH HEAVY-DUTY TURBINES, single-stage, through 2000 hp, for high-pressure, high-temperature service.
- F-8603-A—INTEGRAL GEAR UNITS, combining Type C turbines and matched reduction gears.
- B-2278—COUPLED REDUCTION GEARS.
- B-2198-A—"ECONOMICAL POWER"—covering larger industrial turbine-generators producing both process steam and electric power.
- B-3097—CONDENSERS, all types and capacities, for turbine applications.
- F-8446—AIR EJECTORS, for maintaining vacuum in condensers, etc.
- B-2162-A—FEED-WATER HEATERS.
- B-2196-A—LINK-GRATE STOKERS—single retort.
- B-3039—LINK-GRATE STOKERS—multiple retort.

see steam headquarters first"

Westinghouse supplies

65% of all power plant equipment

1. equipment

A *complete* range of steam turbines for mechanical or generator drive, from 5 hp to the largest; reduction gears to provide most desirable speed for any drive; condensers for all applications; feed-water heaters, steam-jet air ejectors, make-up evaporators, circulating and condensate pumps, stokers, ash evacuators—plus driving motors, control, and distribution equipment.

2. engineering

A complete engineering service to help you select and supply the steam equipment for top over-all efficiency and economy in your power plant.

this unit-responsibility will speed selection and installation of auxiliary equipment

You can avoid the difficulties sometimes involved in co-ordinating power plant operation, making sure each unit contributes its full share towards meeting over-all plant efficiency by placing with Steam Headquarters responsibility for solving your steam auxiliary problems.

A glance at the chart shows that Westinghouse supplies a surprisingly large proportion of all power plant equipment—as much as 65%, to be specific. (Westinghouse equipment illustrated in darker color.) Each one of these varied products incorporates in its basic design the combined thinking of product specialists and steam plant engineers. Modern steam practice demands close co-ordination and a high degree of reliability in auxiliary equipment. To get all the benefits of modern steam practice — it will pay you to see Westinghouse first.

J-50419

Westinghouse

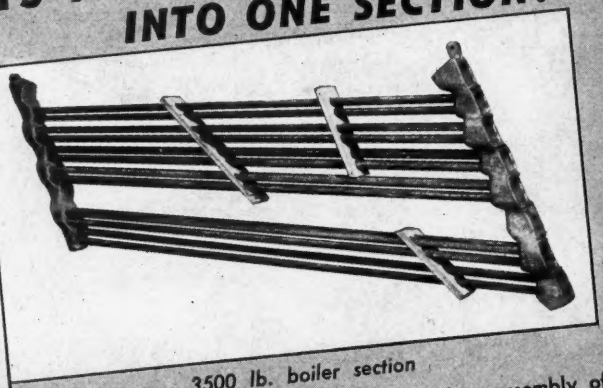
WESTINGHOUSE W

REDUCE BOILER

Speed up job completion

THESE BOILER PARTS ARE SHOP ASSEMBLED INTO ONE SECTION!

22 tubes, 3" O.D. x 20 ft. long
2 boiler headers, 3 baffle sections

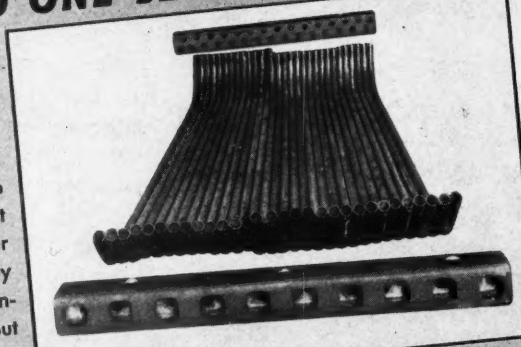


3500 lb. boiler section

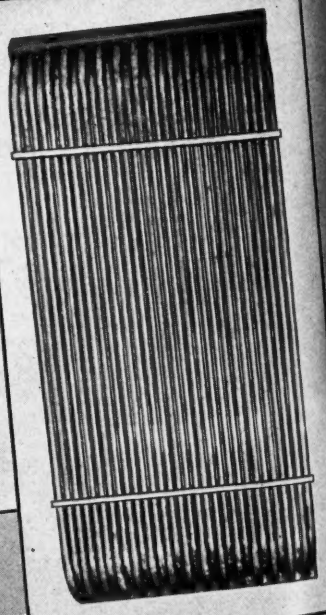
Sectional header design makes possible shop assembly of even the largest units. A double row of tubes in each section insures necessary sturdiness for shipping. No re-rolling of joints necessary in the field.

THESE WATER WALL PARTS ARE SHOP ASSEMBLED INTO ONE SECTION!

Springfield close spaced water walls, because of the close tube spacing and double row of tube connections to each header, are readily assembled into sections sturdy enough to withstand shipping without damage. The size of water wall sections is determined by shipping limitations and conditions at site of erection, but sections may nearly always be 9 ft. wide and often 10 ft. wide.

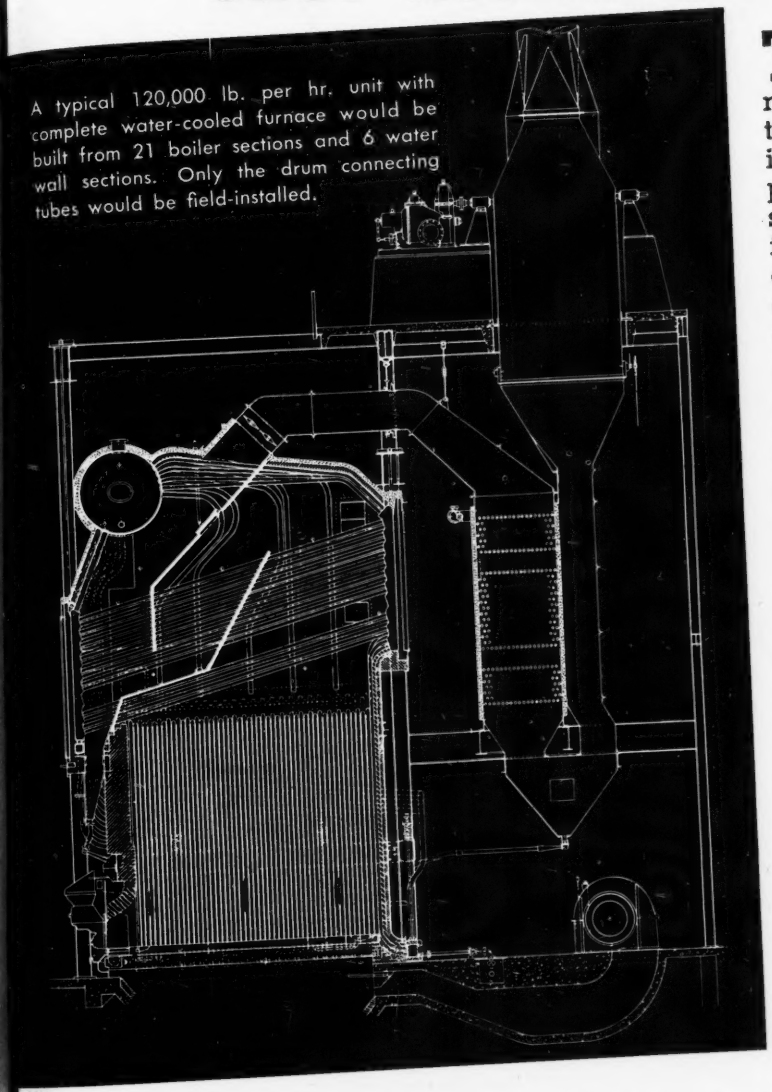


30 tubes, 3" O.D. x 22 ft. long
2 water wall headers



5200 lb. water wall section

ERECTION TIME...
with SPRINGFIELD
SHOP ASSEMBLED SECTIONS



A typical 120,000 lb. per hr. unit with complete water-cooled furnace would be built from 21 boiler sections and 6 water wall sections. Only the drum connecting tubes would be field-installed.

THE advantages of Springfield boiler design have never been more valuable than today, when getting war plants into production in the quickest possible time with the least possible labor is so essential. The fact that Springfield water walls and boiler sections are shop assembled offers you these important advantages:

TIME SAVING IN THE FIELD — As many as 30 to 60 days can be saved on boiler erection time according to actual records.

BETTER WORKMANSHIP — Shop assembled sections have the benefit of all necessary tools and facilities as well as experienced, competent workmen, neither of which are always available in the field.

LESS LABOR REQUIRED — Fewer skilled men and less man hours are required for Springfield boiler erection.

Write to Springfield today for complete information on boilers for your requirements. Any size, any pressure. Also a broad range of possibilities on duplicate units to meet your needs. SPRINGFIELD BOILER CO., 1951 East Capitol Avenue, Springfield, Illinois.

SPRINGFIELD

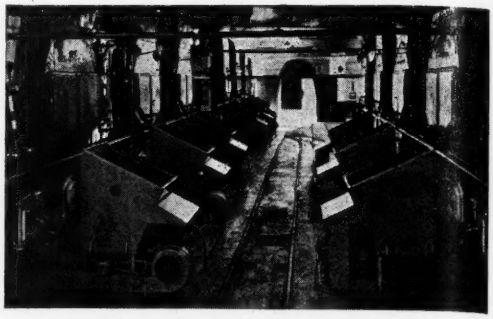
STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

WACO DOUBLES STEAM OUTPUT WITH IRON FIREMAN STOKERS

LAST year Waco Aircraft installed Iron Fireman stokers to replace another type of firing equipment which could not carry the steam load for heating and processing. The plant's capacity was expanded and with even a greater steam demand, two Iron Fireman pneumatic spreaders, firing one boiler, carry the load that required two boilers before.

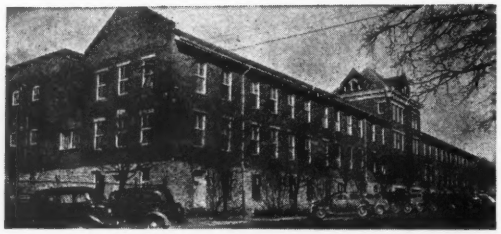


Bear Creek Pumping Station of National Transit Co., Parker's Landing, Pa.

IRON FIREMAN DELIVERS GREATER FIRE POWER FOR OIL PUMPING STATION

URGENT war needs make it necessary to operate the Bear Creek Oil Pumping Station of the National Transit Co. at top efficiency 24 hours a day, 7 days a week. Here 9 Iron Fireman Poweram underfeed stokers are maintaining a steady steam pressure, under heavy load conditions, that enables the pumps to operate continuously, at top capacity.

IRON FIREMAN Stokers



American Pad & Textile Co., Greenfield, Ohio

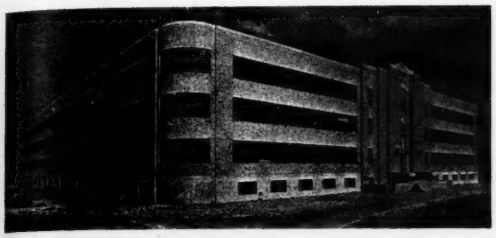
TEXTILE PLANT DOUBLES PRODUCTION NO INCREASE IN FUEL COSTS WITH IRON FIREMAN

WAR orders have more than doubled the production of the American Pad & Textile Co. Yet the plant has been able to operate with the same boilers as before with no increase in fuel costs. Here three Iron Fireman pneumatic spreader stokers fire 200 horsepower boilers.

Pacolet Manufacturing Co., New Holland, Ga.

IRON FIREMAN CUTS STEAM COSTS $14,784 A YEAR AT PACOLET MILLS

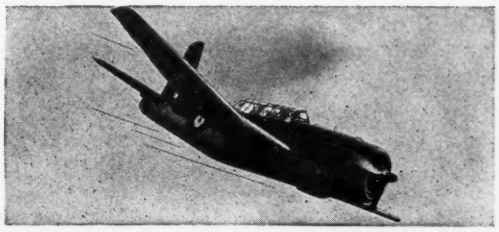
IRON FIREMAN spreader stokers have reduced fuel costs 32% at the Pacolet Mills, now actively engaged in war production. The investment will liquidate itself in a short time and the savings can then be used for war bonds and taxes.



U. S. Department of Agriculture Laboratory, Wyndmoor, Pa.

IRON FIREMAN DEVELOPS 79.6% EFFICIENCY AT WYNDMOOR LABORATORY

AFTER this plant was put into operation, and official tests were made by the U. S. Bureau of Mines Fuel Economy Service, the boiler efficiency proved to be 79.6%, approaching the maximum for simple boiler design without extended-heating surface. Three 2000-lb. per hour Iron Fireman pneumatic spreaders produced this remarkable result.

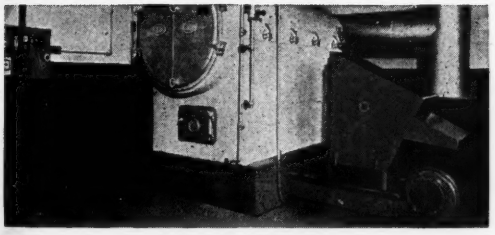


VULTEE AIRCRAFT INSTALLS 9 IRON FIREMAN STOKERS IN ITS NEW PLANT

VULTEE reports the following accomplishments with Iron Fireman firing: A steady supply of steam, right around the clock, even after heavy withdrawals of process steam; no smoke nuisance; clean boiler room and surroundings. Nine Iron Fireman "Coal Flow" stokers provide the process and heating system steam.

are Doing Vital War Jobs

★ ★ ★ ★ ★ ★ *Iron Fireman stokers . . .*



Berwick Weaving, Inc., Berwick, Pa.

PENNSYLVANIA PLANT CHANGES TO COAL . . . SAVES $3000 A YEAR

AT the Berwick Weaving plant, an Iron Fireman Poweram saves over $3,000 annually in fuel costs. In addition, uniform temperature, so necessary in textile manufacture, is maintained. Today, in tens of thousands of boiler rooms, Iron Fireman coal stokers, burning an unrestricted fuel, are helping vital war industries meet war needs by stepping up steam output 10% to 35%.

1 Increase steam output from 25% to 50% in existing boilers. Provide greater fire power for war production. ★ ★

2 Burn coal, America's plentiful fuel. Provide plants converting from oil and gas with vital steam and heat necessary to carry on war production.

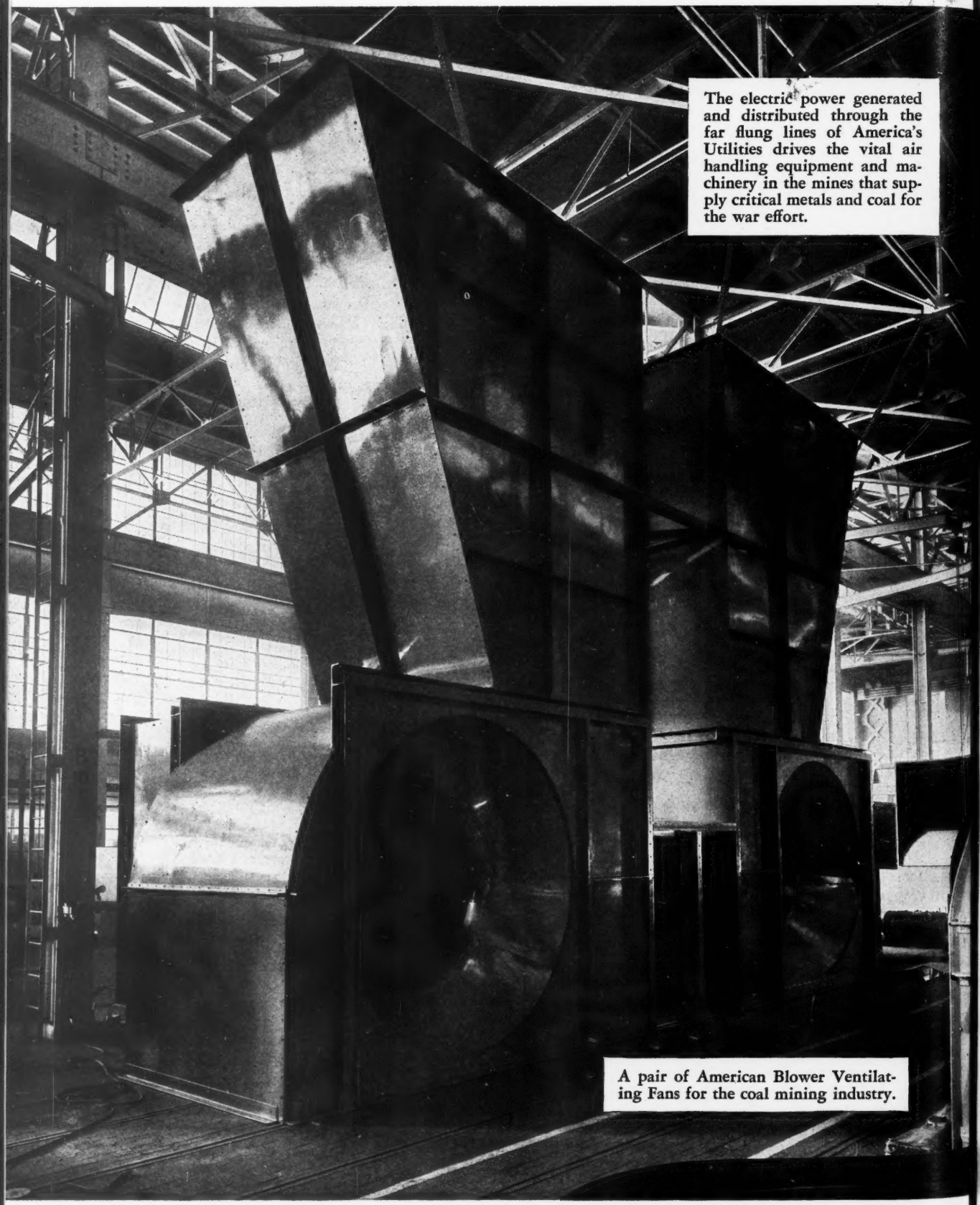
3 Save critical materials. When steam step-up is necessary, new or large boilers need not be purchased, for very often two stoker fired boilers will do the work of three hand fired boilers.

4 Save money for bonds and taxes. Many thousands of Iron Fireman stokers now in operation are saving vast sums of money that can be put into war bonds or applied on the increasing tax load.

Give Iron Fireman an opportunity to show what can be done in your boiler room. Iron Fireman stokers are still available for industrial uses. Write, wire or phone, Iron Fireman Mfg. Co., 3513 W. 106th St., Cleveland, O.

IRON FIREMAN Automatic Coal Stokers

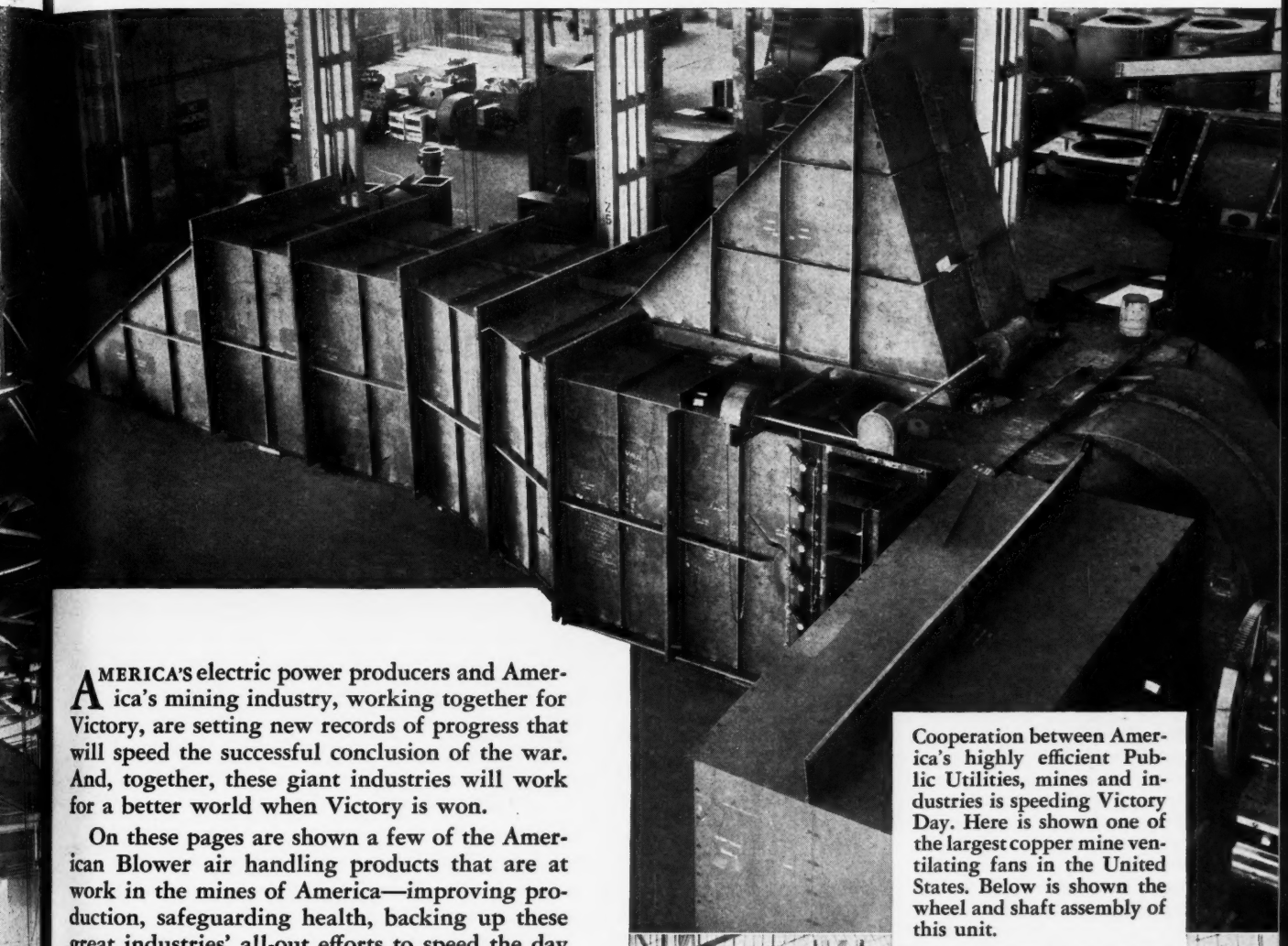
Progress and Power in the



The electric power generated and distributed through the far flung lines of America's Utilities drives the vital air handling equipment and machinery in the mines that supply critical metals and coal for the war effort.

A pair of American Blower Ventilating Fans for the coal mining industry.

MINING INDUSTRY



Cooperation between America's highly efficient Public Utilities, mines and industries is speeding Victory Day. Here is shown one of the largest copper mine ventilating fans in the United States. Below is shown the wheel and shaft assembly of this unit.

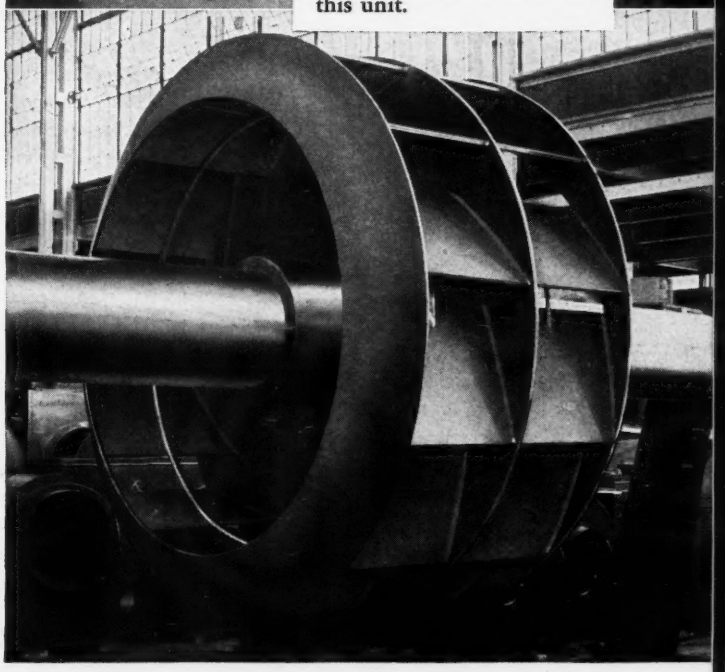
AMERICA'S electric power producers and America's mining industry, working together for Victory, are setting new records of progress that will speed the successful conclusion of the war. And, together, these giant industries will work for a better world when Victory is won.

On these pages are shown a few of the American Blower air handling products that are at work in the mines of America—improving production, safeguarding health, backing up these great industries' all-out efforts to speed the day of Victory.

American Blower Mechanical Draft Fans and Fluid Drives are a familiar sight, too, in the power plants that supply the electric energy for mining. We are continuing our all-out efforts to serve the cause of Freedom on all production fronts.

ARMY E NAVY
Our plants fly the Army-Navy "E."

MECH-O-RANT · AIR-CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS



AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN Radiator and Standard Sanitary Corporation

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 3

Knowing the Conditions . . . First Step Towards Longer Tube Life

Oxygen Concentration

The corrosion of most ordinary industrial metals and alloys usually requires the presence of oxygen. Its function is chiefly that of a depolarizer, oxidizing and removing the atomic hydrogen which is formed during the initial stage of corrosion, thereby allowing corrosion to proceed. The rate of corrosion of metals and alloys immersed in water is in most cases directly dependent upon the rate at which oxygen or any oxidizing agent can reach the surface to depolarize the hydrogen. In many cases, the rate of corrosion is almost directly proportional to oxygen concentration.

Composition of Corrodent

The influence of the degree of acidity or alkalinity and of oxygen or oxidizing materials on corrosion have been discussed. There are many other substances sometimes occuring in circulating media which may have a marked influence on corrosion of the tubes in a heat exchanger. These are listed and discussed as follows:

1. Carbon Dioxide is always present in air and is generally present in water, particularly in swamp and well waters. A solution of carbon dioxide in water reacts acid (carbonic acid) and, like other acid solutions, it accelerates corrosion. In the presence of dissolved oxygen, the rate of corrosion of carbonic acid waters may be particularly high.

2. Chlorine dissolves in water with the formation of hydrochloric and hypochlorous acids and such a solution may be very corrosive when appreciable quantities of chlorine are present. Fortunately, chlorine is not normally found in natural waters and, in the amounts usually added for the control of bacteria and algae, etc., it has no appreciable effect on corrosion. If added in uncontrolled amounts to water supplies, however, serious corrosion may result particularly near the feeding location. Trouble has also been experienced in industries where large amounts of chlorine or active chlorine compounds are used for bleaching purposes.

3. Hydrogen sulphide is a very active corroding agent even when present in relatively small amounts in circulating media. It is an acid and attacks most metals and alloys even in the absence of oxygen. Corrosion is usually of the concentration cell type, resulting in extensive pitting of the metal surface. Hydrogen sulphide and other active sulphur compounds are found in peaty soils, sewage, mineral waters, and in crude oils and other oil-refinery products. In the presence of oxygen, hydrogen sulphide may be oxidized to sulphurous and sulphuric acids.

4. Moist ammonia vapors or water solutions containing appreciable amounts of ammonia have a very marked solvent action on copper and copper alloys; in addition, brasses of high zinc content (the yellow brasses) are attacked intergranularly by ammonia and its compounds, which may promote cracking of the metal in the presence of internal or external stresses. Ammonia is not often found in harmful quantities in natural waters. High concentrations may build up in the condensate of steam condensers where waters containing small percentages of ammonia are used for boiler water supplies. Ammonia is used quite extensively for the neutralization of acids in oil and gas vapors in refineries and should be controlled within very close limits to avoid corrosion and cracking of copper alloy tubes. Ammonia is also used in refrigerating systems and, through leakage, may be a source of contamination of circulating water used for condensers, heat exchangers, etc., in plants where both types of equipment are in service.

5. Salts in solution may retard or increase corrosion, depending upon their composition, concentration, conductivity, and other factors.

Factual Information Service Saves Costly Delays and Scarce Metals for Wartime Tube Users

The discussion of conditions affecting efficiency of Condenser and Heat Exchanger tubes, which appears on these pages, is one of Scovill's continuing series of informative bulletins available to all tube users today. Reprints of this article, together with Numbers 1 and 2, are available on request. To keep tubes in service under wartime conditions, a complete "Condenser Tube Booklet" is also available, with diagrams, formulae and authoritative discussions of types of corrosion, selection of alloys, and solutions of special maintenance problems. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Sea water, containing approximately 3 % sodium chloride and minor amounts of potassium chloride, magnesium chloride, magnesium sulphate, calcium sulphate, et cetera, is not in itself a serious corroding agent of copper and copper alloys. It is important to note, however, that sea water may carry appreciable amounts of other substances, depending on location, the season of the year, et cetera, which may accelerate corrosion materially. It is reported, for instance, that carbon dioxide or hydrogen sulphide in sea water causes the formation of a non-protective scale or film, thereby promoting the formation of concentration cells and intense localized pitting. Carbon dioxide and hydrogen sulphide may both occur only seasonally in harmful amounts. Entrained air in sea water may result in an intense local attack of heat exchanger tubes, depending upon the velocity and turbulence of the water, the size of air bubbles, et cetera. Natural fresh water supplies have a total solid content very much less than that of sea water, usually consisting chiefly of bicarbonates, sulphates, and chlorides. As a general rule, corrosion of copper and copper alloys is not serious in contact with fresh water. In some cases, dezincification has been experienced under some service conditions, but this form of corrosion has been largely overcome by the choice of a proper alloy; also, suspended solids or foreign material in fresh water may initiate "deposit attack" of the metal, but this type of attack can also be overcome successfully in most cases by screening of the water and a frequent cleaning of the tubes. Acid drainage from coal mines is discharged into many streams and may cause serious corrosion, depending upon the acid concentration and the presence of oxidizing agents, such as ferric sulphate; under conditions of this kind, relatively rapid uniform etching of condenser and heat exchanger tubing does take place.

Stresses Acting upon Tubes

Stresses which may initiate or contribute to the failure of heat exchanger tubes may be classified as follows:

1. Internal strains set up by cold working.
2. Externally-applied tensile stresses.
3. Cyclic stresses.

Season cracking or corrosion cracking of brasses is the result of corrosion by specific reagents and particularly by mercury and mercury compounds and ammonia and ammonium compounds on *internally stressed* material. Cracking usually follows the grain boundaries.

Stress-corrosion cracking is similar to season cracking except that the stresses are externally applied.

Corrosion-fatigue cracking of tubes may occur from the simultaneous action of corrosion and *cyclic stresses* acting on the metal. In this connection, it should be noted that cyclic stress tends to accelerate corrosion of the pitting type, and corrosion, on the other hand, decreases the fatigue limit very markedly. Corrosion-fatigue cracks are trans-crystalline.

Contact with Dissimilar Metals

When dissimilar metals are in contact with each other and are immersed in a conducting medium, one metal (the anodic metal) undergoes an accelerated corrosion and the other (the cathodic metal) is correspondingly protected. Perhaps one of the most important controlling factors in corrosion of this type is the ratio of the cathode area to the anode area. As a general rule, the larger the cathode area, the greater is the corrosion at the anode. Other factors which influence galvanic corrosion are the resistance of the electrolyte, the formation of protective films or corrosion product over the metal surfaces, et cetera.

A 3-Way Service for Your Firm

The services which Scovill offers to its customers, and to every wartime user of Condenser and Heat Exchanger tubes, are not limited to the "Service in Manuals" described above. Scovill's "Service in Men" places at your disposal the advice and consultation of men with years of experience in practical tube problems; while Scovill's "Service in Metals" offers you complete laboratory and production facilities, available as national needs permit.

Limitation order L-154 issued by the OPM. This order limits the use of non-ferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No non-ferrous metals containing more copper and more tin than these two are permitted by the order.

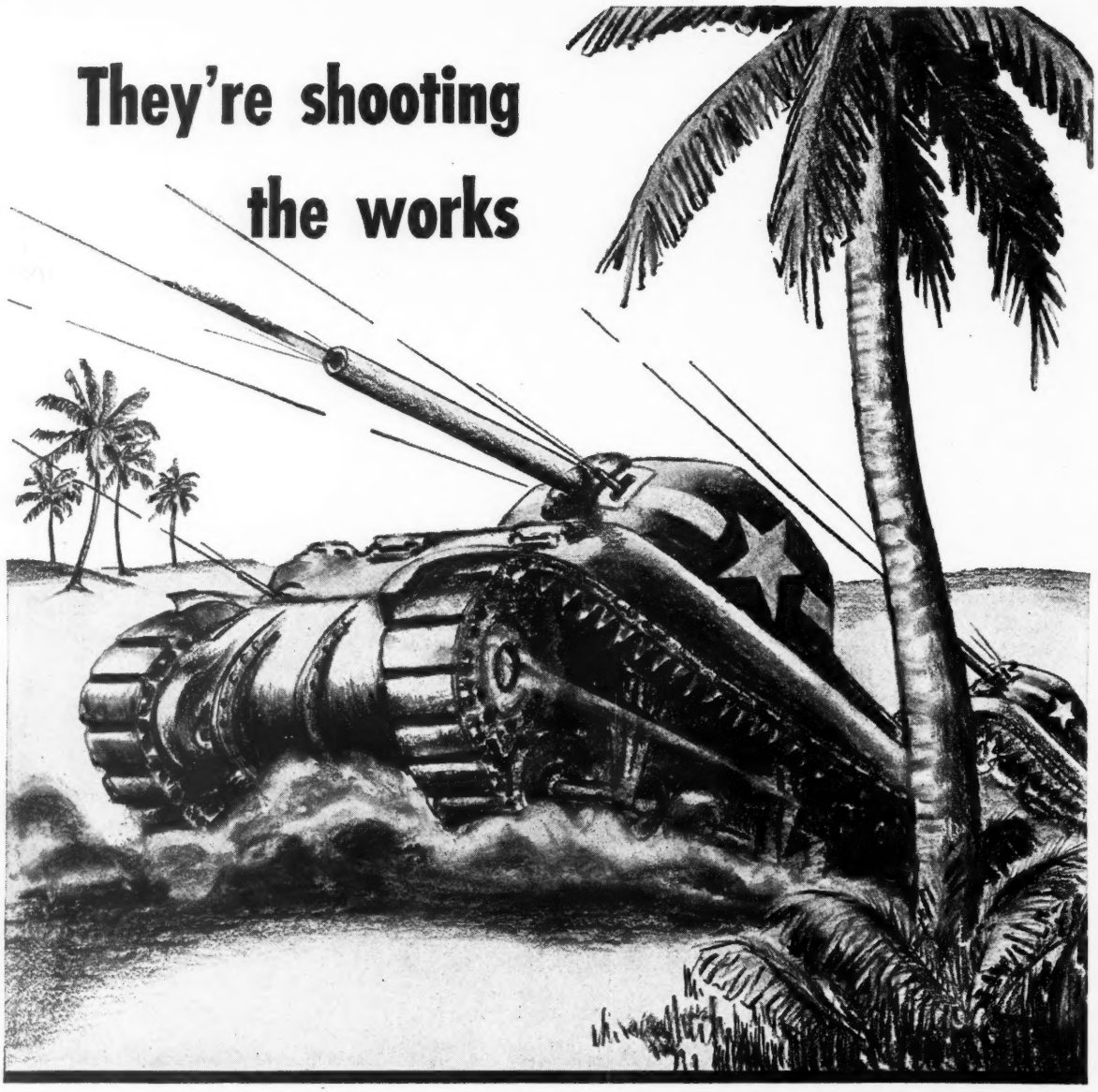
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

They're shooting the works



and they're relying on us!

The men in our armed forces are giving everything they've got to this fight for freedom—and they're depending on us back home to supply the tools of war.

One way to help maintain war production at full capacity is to use *quality* packings, gaskets and oil seals—and use the proper material for each requirement. A GARLOCK representative will be glad to advise you. Call him in!

Garlock

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Safer Boiler Operation
Easier Maintenance with

SPECIFY! ERNST FITTINGS

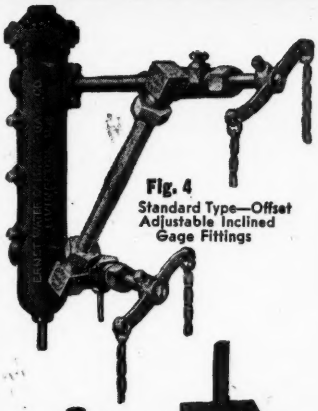


Fig. 4
Standard Type—Offset Adjustable Inclined Gage Fittings

Fig. 9
Wire Glass "Better-C" Guards, All Sizes

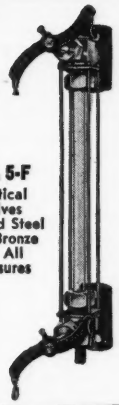


Fig. 5-F
Vertical Valves Forged Steel and Bronze for All Pressures

Fig. 10
Illuminators—"Plain Sight"

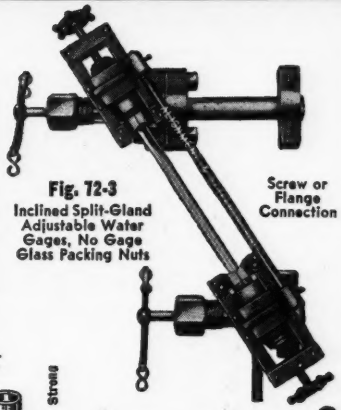


Fig. 72-3
Inclined Split-Gland Adjustable Water Gages, No Gage Glass Packing Nuts

Screw or Flange Connection

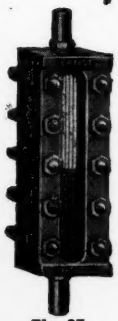


Fig. 37
"C-BLACK" Prismatic Flat Glass Inserts

Fig. 45
"C-Clear Thru" Flat Glass Inserts

Fig. 18 Fig. 19
FLAT GLASSES

GAGE GLASS GASKETS

Standard Pattern Gaskets
High Pressure
Fig. 22
Non-hardening and Non-softening SERIES 750

Send for Gasket Tag showing sizes

GASKETS THAT WILL FIT EXACTLY

Lip-meld Pattern
Fig. 21
Expansion Type Gasket

Fig. 12 Fig. 23 Fig. 14

Fig. L-150
Steam Metal Bronze Gage for pressures up to 150 pounds

LEAKLESS COCKS

Bronze or Forged Steel
Fig. 13
For All Pressures

Fig. 16

For Pressures Up to 250 lb. — This Ernst DCP (Double Chain Pull) Try Cock insures a tight shut off. Order in sets of 3 to complete one water column.

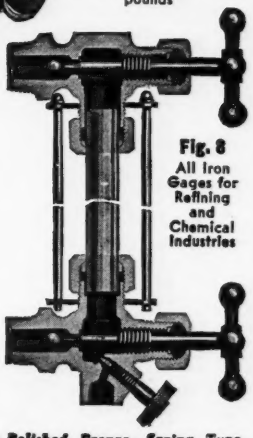


Fig. 8
All Iron Gages for Refining and Chemical Industries

Fig. 18

SIGHT GLASSES for all types OIL CUPS and LUBRICATORS

Fig. 17

SIGHT FLOW INDICATORS for insertion into Pipe lines
— All Sizes —

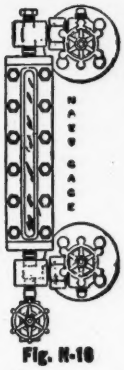


Fig. N-10

We also manufacture..

SAFETY ALARM WATER COLUMNS

FOR ALL TYPES OF BOILERS COMPLETE WITH TRIM

DELIVERIES FROM STOCK
ORDER BY FIG. NUMBERS

SEND FOR COMPLETE CATALOG and State Your Requirements

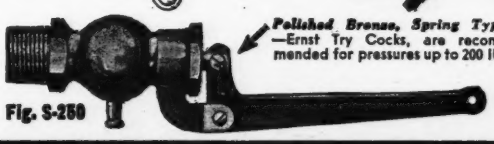


Fig. S-250

Polished Bronze, Spring Type —Ernst Try Cocks, are recommended for pressures up to 200 lb.

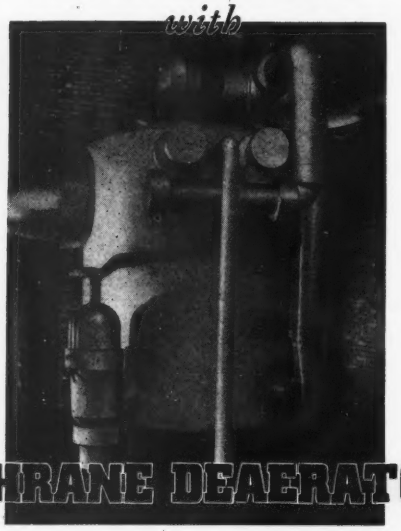
ERNST WATER COLUMN & GAGE CO.

LIVINGSTON, N. J. **Manufacturing For More Than 35 Years** Phone: Livingston 6-0276

GUARDING POWER PLANTS

AGAINST CORROSION . . . . . IS IMPORTANT, TOO

with



COCHRANE DEAERATORS

WHILE danger from enemy attacks on power plants is an ever-possible threat and one against which unceasing vigilance is necessary, there are other ways in which power losses can be sustained . . . less spectacular attacks but in the aggregate affecting millions of boiler horse power. Corrosion from inadequately treated feedwater can be and is being prevented by the use of Cochrane Deaerators.

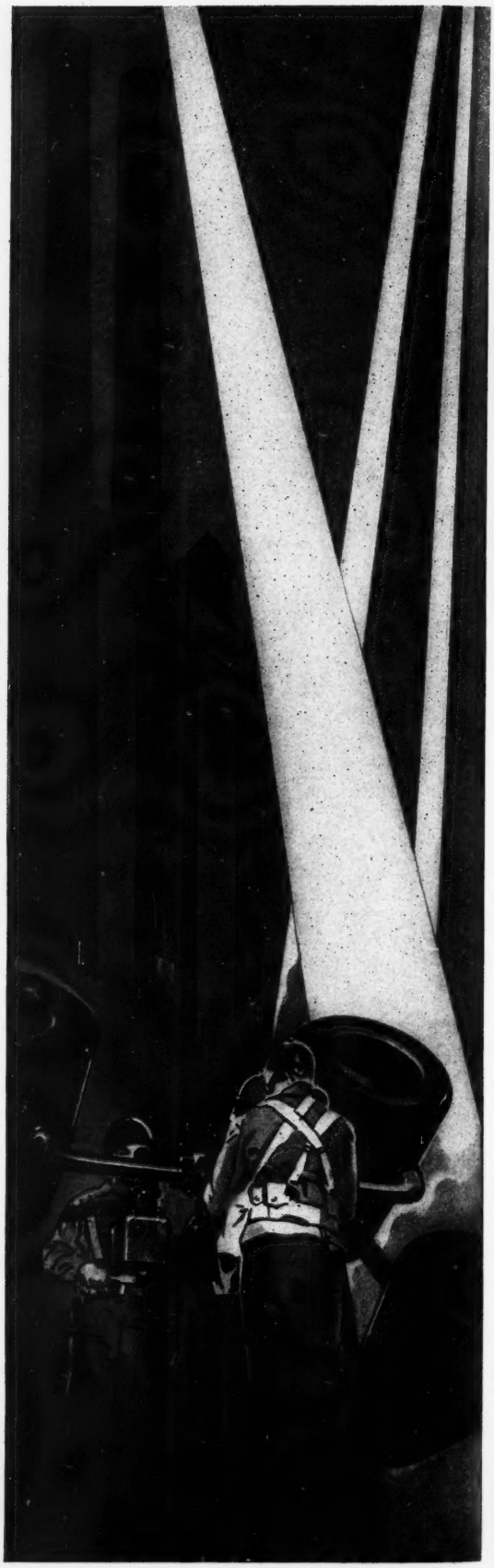
The Cochrane Down-Flow Principle, the most effective for complete deaeration ("zero oxygen") is the basis of Cochrane design; which properly anticipates the influence of all factors, such as inlet oxygen content, operating pressure and temperature, inlet water temperature, vent rate and tray efficiency at various flows. Cochrane Deaerators are available in designs suitable for any class of service and are guaranteed to remove the oxygen as required.

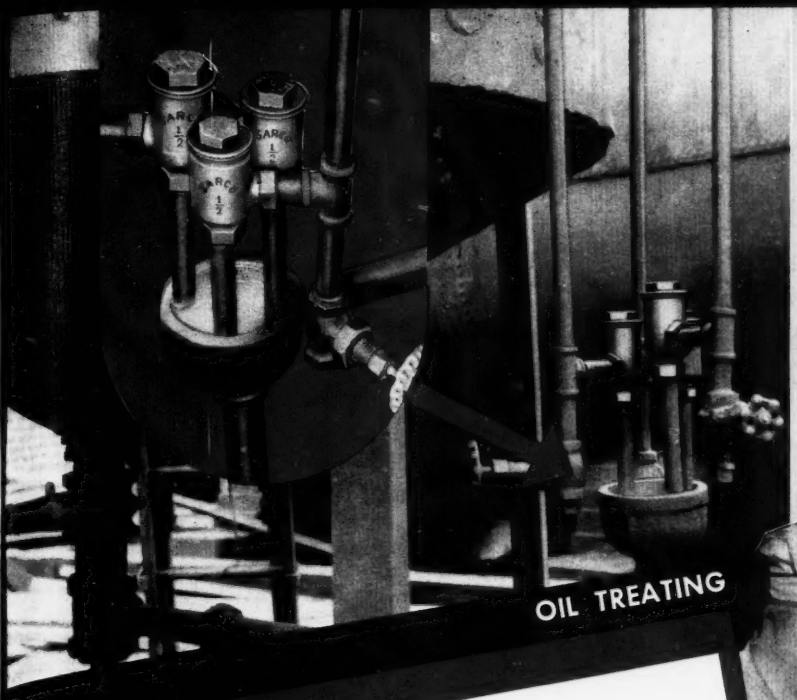
Write for a copy of Publication 2980

COCHRANE CORPORATION • 3123 N. 17th St., Phila., Pa.

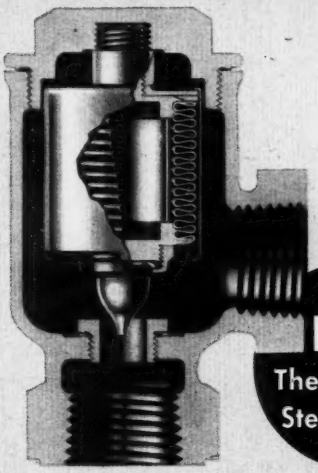
COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES





OIL TREATING



No. 9
Thermostatic
Steam Trap

Guarding Industry's Coal Pile

WITH SARCO No. 9 THERMOSTATIC STEAM TRAPS

Fuel is 1/3 the transport tonnage in the U. S. A. Dead condensate or air in a steam coil wastes fuel and slows up production.

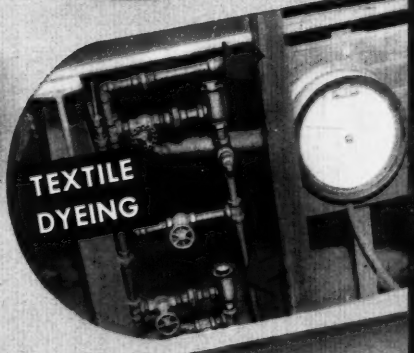
The Sarco Steam trap illustrated on this page says "get out" to spent condensate and gases — and "wait a while" to anything above its discharge temperature. Thus a few ounces of prevention can save tons of coal and hours of valuable production time.

This trap is so inexpensive that it can be used on each steam coil, so no one part of the job can hold up another. Also it's wide open when cool — giving a quick start in the morning. Obviously it cannot freeze.

It is small, light, easy to install and works on all pressures within three ranges. It is the only thermostatic steam trap made for pressures up to 250 lbs. Ask for Catalog No. 250.

FOOD BOTTLING

CHEMICAL COOKING



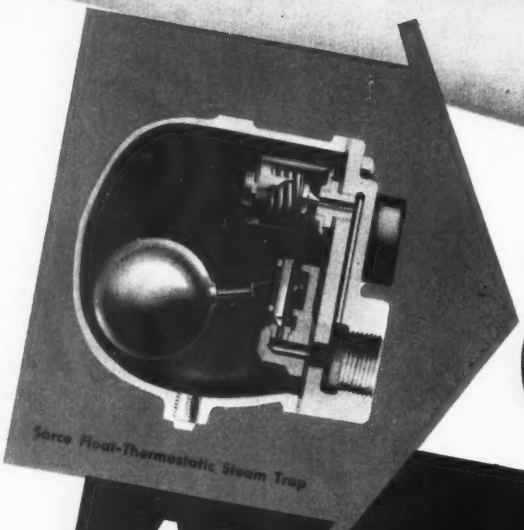
TEXTILE DYEING

SARCO Saves Steam

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Represented in Principal Cities



A Perfect Team FOR PROCESS CONTROL

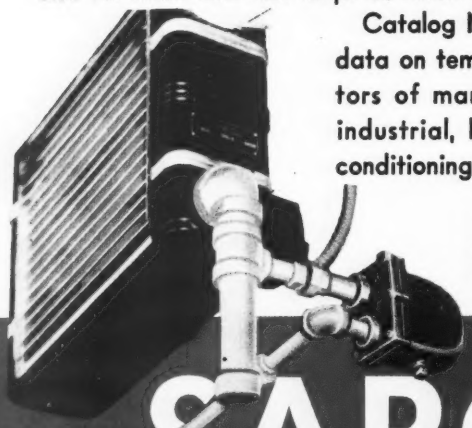
Here are two Sarco products that work well together on heavy duty steam heated equipment requiring accurate temperature control. Sarco float-thermostatic steam traps remove condensate continuously without shock and as fast as it forms.

Sarco self-operated temperature regulators provide gentle, throttling control of the steam supply to maintain desired temperatures within close limits.

Use this team for hot water generators, blast or unit heaters, and all types of process equipment where constant temperatures are important and the steam loads are heavy.

Catalog No. 450 lists Float-Thermostatic Steam Traps also for main and riser drips on steam heating systems.

Catalog No. 600 provides data on temperature regulators of many types for all industrial, heating and air conditioning applications.



Sarco "FT" traps are used on unit heaters by the thousands. Note simplicity of installation.

SARCO
Saves Steam

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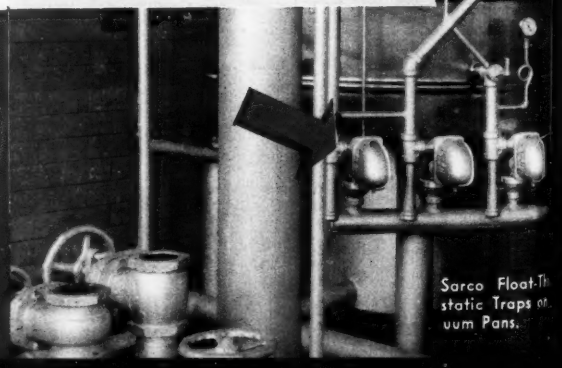


Sarco Float-T
static Traps o
uum Pans.

Motors Run a Fever?

No wonder if they do more often today. They're working 3 and 4 times as many hours a year as in peace!

When a motor runs hot in your plant, do your men have explicit directions for locating the cause? If not, send in for your free copy of "Guide to Wartime Care of Electric Motors". Its QUICK DIAGNOSIS OF MOTOR AILMENTS is invaluable!

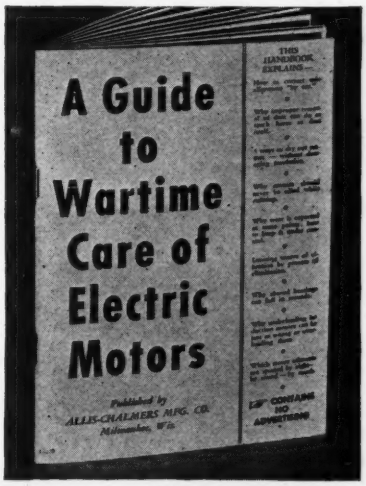
Friction makes heat — and so does electrical resistance. Pages 8 and 9 of Allis-Chalmers' new book tell how wartime preventive maintenance should fight friction . . . pages 16 and 17 outline strategy for preventing overload. Recommendations are simple, practical, *geared to wartime* — ideal for training.

Insulation is "fried" by excessive heat — bearings burned out — soldered connections melted. Play safe . . . put Allis-Chalmers' new motor maintenance guide to work protecting *your* motors!

HERE'S the arithmetic of the wartime motor maintenance problem: motors that worked 1800 hours in a peace year now work up to *8700 hours!*

A killing schedule—yet motors now must last *longer* than ever before — and wishing won't make it so.

One thing will: the new *wartime* standard of motor care set forth in Allis-Chalmers' new motor maintenance guide. Already, 70,000 copies are in use in plants all over the U. S.!



Contents of this valuable new publication include the 9 main enemies of electric motors and how to fight them . . . dust, stray oil, moisture, friction, misalignment, vibration, uneven wear, overload and underload. Send in today for *your* free copy to ALLIS-CHALMERS, MILWAUKEE, WIS. A 1591

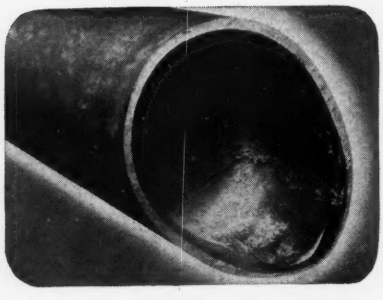
ALLIS-CHALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

It's a good time to

1 TREAT BOILERS CAREFULLY. The treatment for boiler water must be controlled with more care than a baby's formula. Hall Laboratories is completely equipped to analyze boiler water problems from every angle. Only after all factors have been correctly diagnosed do we make recommendations for water treatment.

2 KEEP 'EM CLEAN. Clean boiler tubes are your best assurance of top steam production. Hall Service Engineers inspect your boilers at frequent intervals to make sure that satisfactory water conditions are being maintained.



3 PROTECT OVERWORKED BOILERS. Many boilers are overworked today and may avenge themselves by going off the line for repairs. Hall Service provides for greatest latitude of operation without damaging results.

4 WATCH FOR SIGNS OF TROUBLE. Vigilance should be the power engineer's middle name. If even a paper-thin scale develops in high pressure boilers it is time to call in a Hall Service Engineer. Prompt action can ofter avert trouble.

5 AP op ice for oilers op are toda

to be "nice" to your boilers

You may have felt you could "treat 'em rough" in the "good old days" . . . but not any more

BOILERS and boiler parts are in the semi-precious class today. You've got to nurse, and even pamper, them. And that goes for the duration. They must be made to last.

That's what gives Hall preventive care its great importance. For the application of preventive remedies for the ills of scale, corrosion, carryover and embrittlement is the only real security against boiler failure.

Hall Laboratories fathered the modern system of preventive care, introduced the first scientific treatment of boiler ills arising from water conditions, based their work on the system of administering constant field aid through salaried engineers whose sole interest is devoted to the practice of keeping boilers on the line. Hall Laboratories train these men, give them the support of the world's finest facilities for the diagnosis of boiler troubles, send them out fully equipped with the knowledge and experience needed for their highly technical job.

No other type of service can so effectively and completely meet this industrial need.

A lot of power plant engineers must think so, too, because the finest plants in America practice Hall preventive care. If the most competently equipped and ably manned of these need this service, you need it.

It's not too late. There will never be a better time to find out what preventive care can do for you. Write for particulars.

HALL LABORATORIES, INC. · HAGAN BUILDING, PITTSBURGH, PA.

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HAGAN
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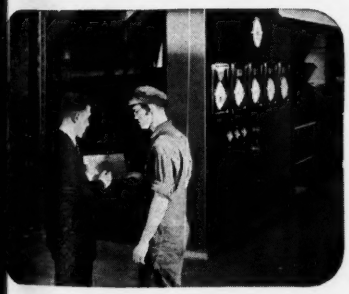
HALL SERVICE IN A NUTSHELL

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.



5 APPLY PREVENTIVE REMEDY. Your operating men working with Hall Service Engineers and Research Chemists form a combination that can keep boilers operating at peak capacity. Preventive care today is aboslutely necessary.

HALL SYSTEM
of Boiler Water Conditioning

10 Ways YOU and WE Can Help Speed Victor

A Mid-West metal distributor received an urgent call from an airplane instrument manufacturer. Unless 125 feet of "R" Monel could be delivered immediately, production of a vital part would be held up. The required metal was delivered from stock the same day. Production continued at top speed.

Additional footage was also supplied to keep the manufacturer going until his mill shipment arrived.

At nine o'clock on a Sunday evening, an Army officer drove to a distributor's office for a rush order of metal to go with a convoy sailing at dawn. The night watchman phoned warehouse employees. The order was filled on time for the convoy's sailing.

★

With all metals and alloys on the critical list, distributor stocks have assumed new importance . . . providing a country-wide pool of materials. Many examples . . . beside the two above . . . could be cited.

Less dramatic . . . but equally important . . . is the day-to-day service provided by INCO distributors. Maintaining complete and up-to-date information about Government orders and regulations saves time and trouble for metal users.

Distributors acquire broad experience in many industries...and familiarity with the fund of technical information made available by the engineering and research staffs of The International Nickel Company. Thus they are equipped to advise about proper uses of metals and alloys...and often help users overcome production difficulties.

What YOU can do:

1 Conform with WPB regulations. New regula-
tions are being issued constantly.

2 Place your orders as early as possible.

3 Indicate alternate choices on sizes and materi
...where possible. By so doing a satisfactory alt
nate may be obtained immediately. Otherwise c
siderable time may be required to obtain the
act size or material indicated.

4 Don't hesitate to ask technical questions a
selection, uses and working of Nickel, Mone
other critical metals. We can often offer su
tions which reduce shop spoilage...and *save*

5 Depend upon us—your metal distributo
as much shop service as possible. Use our fa
to cut down the number of operations i
plant.

What WE can do:

dvise on WPB requirements. Special depart-
s keep fully informed on Government regu-
ns. Help metal users solve priority problems.

Help *new* users of Monel, Nickel, Inconel and
er special alloys. We offer practical advice on
ding, machining, heat treating and other proc-
ng methods.

Special sizes and shapes in stock. Stocks main-
ined complete as possible under wartime condi-
ons. By suggesting alternate sizes or materials,
e often keep production moving.

4 Special services...such as cutting, shearing or sawing to size...help overloaded plant facilities. Delivery as needed keeps metal moving to machines.

5 Mill orders. A close working knowledge of mill conditions enables us to handle mill orders with maximum efficiency, thus helping to relieve the burden on overtaxed mills. We...where possible...offer part shipment from our own warehouse stock.

● By working closely with the distributor, by asking for advice as well as metal, you can eliminate many delays, cut down useless paper work and step up production of finished war materials.

The Companies listed below are Distributors of the INCO High Nickel Alloys:

MONEL • "K" MONEL • "S" MONEL • "R" MONEL
"KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

They also supply other non-ferrous metals such as aluminum, copper and copper alloys.

★

DISTRIBUTORS

Atlanta—J. M. Tull Metal & Supply Co., 285 Marietta St.
Boston—Whitehead Metal Products Company, Inc. 235 Bridge St., Cambridge
Buffalo—Whitehead Metal Products Company, Inc. 254 Court St.
Chicago—Steel Sales Corporation, 3348 South Pulaski Road
Cincinnati—Williams and Company, Inc. 1921-1927 Dunlap St.
Cleveland—Williams and Company, Inc. 3700-3716 Perkins Ave.
Columbus—Williams and Company, Inc., 31 N. Grant Ave.
Dallas—Metal Goods Corporation, 1209 Texas Bank Bldg.
Denver—Hendrie & Bolthoff Mfg. & Supply Co. 1621-39 Seventeenth St.
Detroit—Steel Sales Corporation, 5151 Wesson Ave.
Houston—Metal Goods Corporation, 16 Drennan.
Los Angeles—Pacific Metals Co., Ltd., 1400 S. Alameda St.
Milwaukee—Steel Sales Corporation, 647 W. Virginia St.
Minneapolis—Steel Sales Corporation, 529 S. 7th St.
Newark—Whitehead Metal Products Company, Inc. 205 Frelinghuysen Ave.
New Orleans—Metal Goods Corporation, 413 Canal Bldg.
New York—Whitehead Metal Products Company, Inc. 303 West 10th St.
Philadelphia—Whitehead Metal Products Company, Inc. 721-729 Arch St.
Pittsburgh—Williams and Company, Inc. 901-937 Pennsylvania Ave.
St. Louis—Steel Sales Corporation, 4565 McRee Ave.
San Francisco—Pacific Metals Co., Ltd., 3100 – 19th St.
Seattle—Eagle Metals Co., 3628 E. Marginal Way

IN CANADA:
Montreal—Robert W. Bartram Ltd., 277 Duke St.
Toronto—Alloy Metal Sales Ltd., 861 Bay St.
Vancouver—Wilkinson Company, Ltd., 190 Second Ave., W.

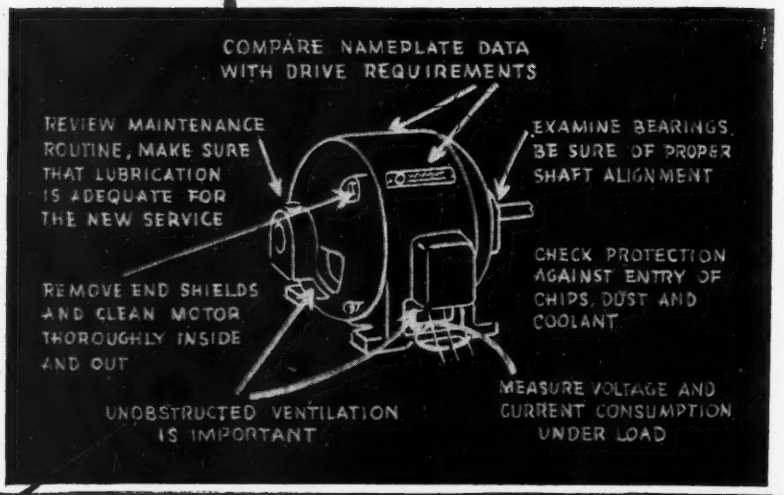
Inco Distributor Service

MILL...WAREHOUSE...FIELD

INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

MOTOR CARE

IT'S TIME TO BE A CRANK ABOUT


COMPARE NAMEPLATE DATA WITH DRIVE REQUIREMENTS
REVIEW MAINTENANCE ROUTINE, MAKE SURE THAT LUBRICATION IS ADEQUATE FOR THE NEW SERVICE
EXAMINE BEARINGS. BE SURE OF PROPER SHAFT ALIGNMENT
CHECK PROTECTION AGAINST ENTRY OF CHIPS, DUST AND COOLANT
REMOVE END SHIELDS AND CLEAN MOTOR THOROUGHLY INSIDE AND OUT
UNOBSTRUCTED VENTILATION IS IMPORTANT
MEASURE VOLTAGE AND CURRENT CONSUMPTION UNDER LOAD

protect your production with this maintenance plan

Planned motor maintenance, keyed to today's loads and conditions, saves vital hours by forestalling future breakdowns and delay. In replacing hit-or-miss motor service with a regular schedule of trouble-*prevention*, you'll find real help in the new G-E publication, "How to Care for Motors."

The check list (right) tells what to do. This book tells how to do it, using well-proved methods that save time and help assure long-lasting motor service.

And, of course, your local G-E Motor Representative is always ready to aid you in putting these suggestions into practice, or in getting the new motors you may need for essential wartime projects.

1. Make sure that motors are selected to *match the job.* Install motors so they are properly aligned with the driven load and are easily accessible for regular inspection.

See "How to Care for Motors"

2. Keep motors free from dust and dirt. Establish a definite cleaning schedule.

See "How to Care for Motors"

3. Be sure that lubrication is frequent enough to take care of increased production. See that employees are instructed as to proper methods.

See "How to Care for Motors"

4. A general overhauling of hard-worked motors will add years to their life. If your motors haven't had an overhaul in the last year, try to arrange your schedule to permit one.

See "How to Care for Motors"

General Electric, Sec. PL 750-179C
Schenectady, N. Y.

Yes, send me a copy of "How to Care for Motors," GEA-2856A.

Name.....

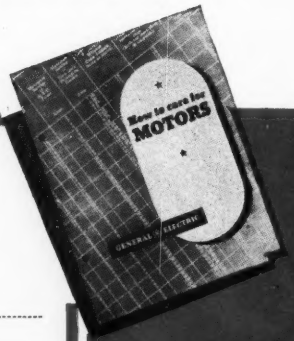
Title.....

Company.....

Address.....

City.....State.....

8080



HOW TO CARE FOR MOTORS

Every supervisor and maintenance man will find this book of value . . . it tells what to do to get the most out of motors, old or new. If you're setting up a maintenance program to keep up with today's unprecedented demands, or if you're "switching" motors from one job to another, or equipping machines with new motors, you'll find this booklet of helpful motor facts will save you time. Write for a copy.

BUILDER OF TRI CLAD MOTORS

GENERAL ELECTRIC

FULL CAPACITY WITHOUT WASTE OR OUTAGE

Bailey Boiler Control Insures Safe Economical Operation At High Rates of Steaming

★ Full capacity is obtained from a steam generating unit only when the many factors which enter into its operation and control are carefully coordinated and accurately maintained at their optimum values.

Care must be taken in approaching these optimum values since serious waste and danger of breakdown is likely to occur unless dependable measurements of the factors are made and continuous vigilance is exercised in their control.

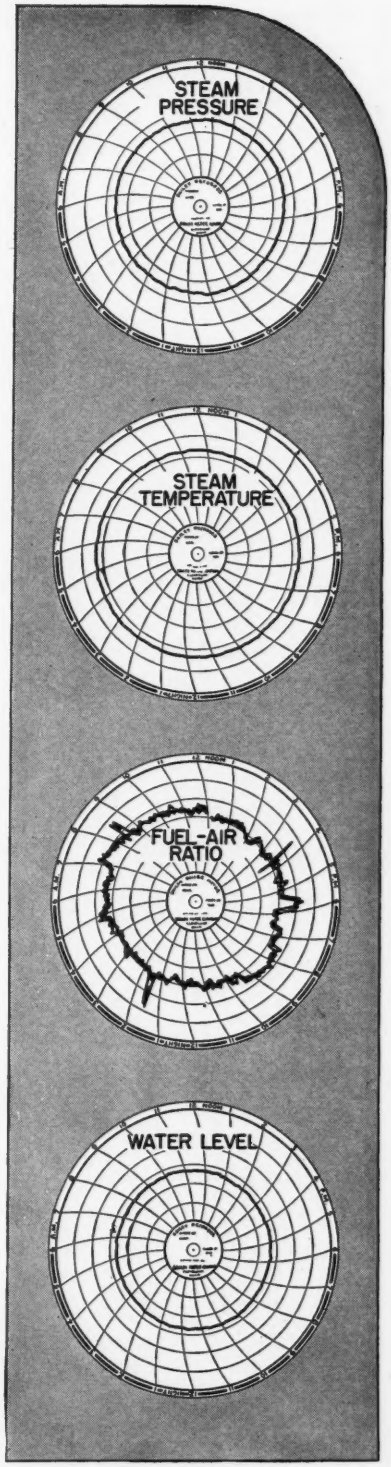
Blind efforts to increase boiler capacities by raising combustion efficiency may result in waste of fuel and in serious damage to boiler furnaces.

High capacities may be safely and economically attained with the help of Bailey Boiler Control which continuously maintains the following factors at their optimum values:

1. Steam pressure; to provide maximum turbine efficiency and to prevent waste through safety valves.
2. Steam temperature; to provide maximum turbine efficiency and to prevent damage resulting from excessive temperatures.
3. Fuel—Air Ratio; to keep to a minimum the volume of gases which must be moved through the boiler per unit of heat release, and to reduce excess air loss to a minimum without decreasing fuel economy or damaging furnace refractories.
4. Feed water flow and level; to maintain a uniform heat demand and to avoid both "high" and "low" drum level.

Bailey Meter Control serves the war effort by making it possible for power engineers to carry on with safety and economy at full capacity in spite of wartime scarcities.

A-88-1



BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

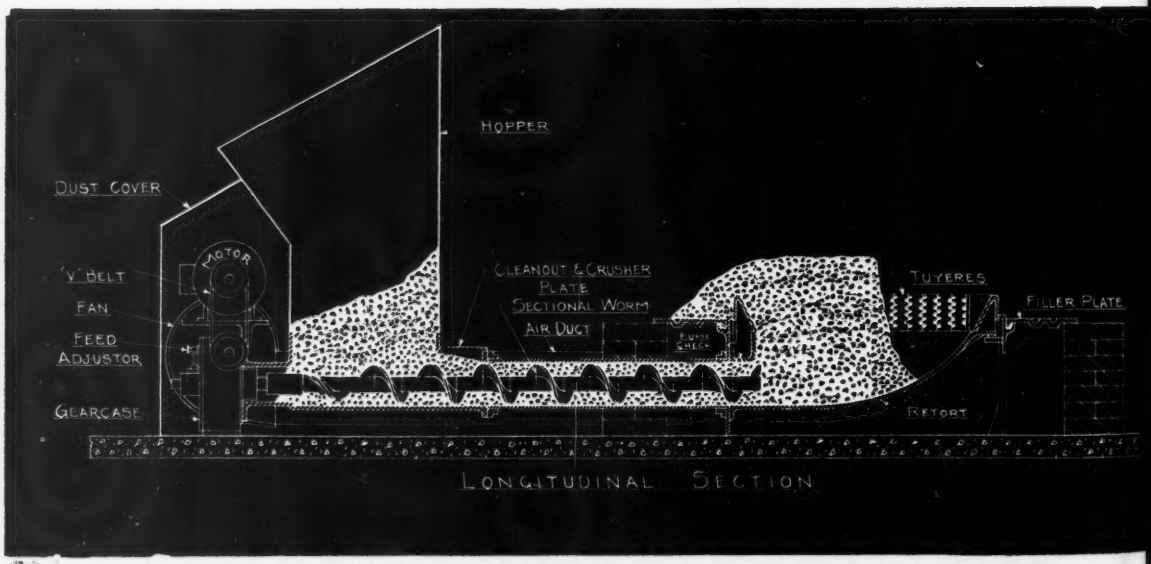
also...

CANTON STOKER

EXTRA HEAVY WORM FEED CANTON STOKERS

. . . for the smaller boilers

Worm Feed Type Illustrated Below



Cutaway view showing assembly of DeLuxe Stoker and method of feeding coal. This gives you a complete picture of the stoker's action, along with good views of the various components that go to make up the entire stoker.

CANTON STOKER CORP.

Mfgrs. of Vulcan Ramfeed Stokers . . . up to 850 H.P.
Lo-Set Ramfeed Stokers . . . up to 450 H.P.

Mfgrs. of Deluxe Wormfeed Stokers . . up to 175 H.P.
Standard Wormfeed Stokers . up to 125 H.P.

. . . convert now from

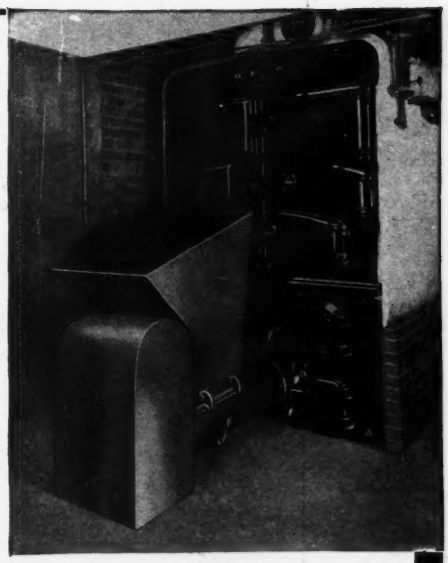
OIL to COAL!

Canton Standard and DeLuxe Side Dump WORM FEED Stokers are, generally speaking, smaller editions of the recognized, approved CANTON VULCAN and LO-SET RAMFEED Stokers, widely used on High Pressure Power and Process Boilers. Like their larger counterparts, they're carefully engineered and built with precision, so as to get the best performance from each type of boiler.

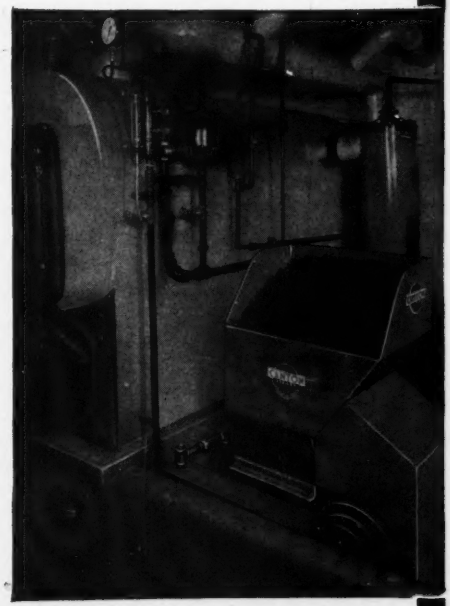
Simple and sturdy in design, these smaller units operate at low cost . . . . are seldom "off the line" for servicing . . . reduce fuel costs by producing more heat from the fuel . . . . burn cheaper grades and sizes of coal . . . . eliminate soot in boiler flues.

With these Canton Stokers in service on your boilers, you can go a long way toward achieving labor conservation, more constant steam pressures, stepped-up production, reduced spoilage and compliance with local smoke ordinances.

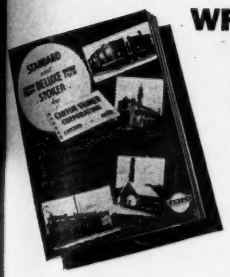
Surely, an investment in these Stokers will quickly liquidate itself in savings and service. Want complete details? . . . . . fill in and mail the attached coupon, or, write, wire or phone our nearest office or our factory and ask for a Free Consultation on Combustion Problems . . . . our staff of Field Engineers is at your Service.



DeLuxe Side Dump Stoker adapted to a Cast Iron Sectional Boiler. The Fu'l Front adds trimness to the job, as well as providing accessibility and cleaner operations.



Clinker Plate installation made from side of Boiler. Where space in front of Boilers is limited, a side installation often provides a practical solution.



WRITE FOR THIS CATALOG

Here you'll find all the pertinent data that will enable you to intelligently plan for and use CANTON STANDARD and DELUXE Stokers.

00 ANDREW PLACE, S.W.

ANTON ● OHIO

CANTON STOKER CORPORATION
900 Andrew Place, S.W., Canton, Ohio

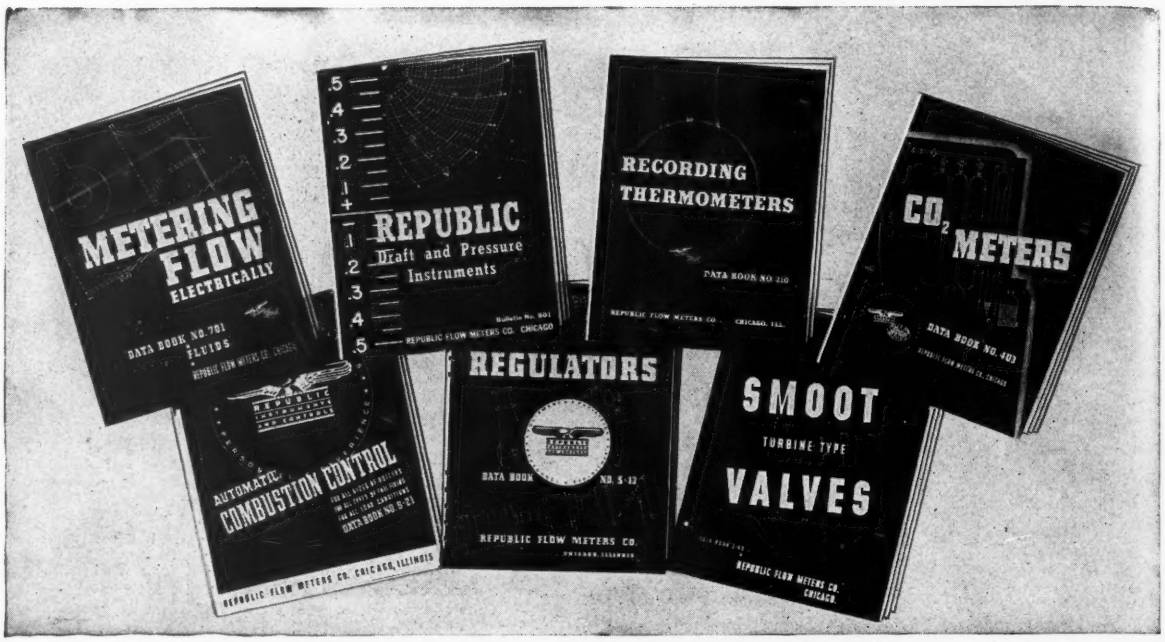
Gentlemen:
Please send me at once your new catalog covering the Standard and DeLuxe Extra Heavy Worm Feed Stokers for conversion from oil to coal.

Name.....

Company.....

Address.....

City..... State.....



These Data Books
WILL HELP YOU SOLVE YOUR POWER PROBLEMS

Write for these data books now! When your increased power load demands the installation of new units or the "stretching" of existing plant capacity, you will need this information.

REMOTE READING FLOW METERS—Data Book No. 701

For measuring flow of steam generated by each boiler and the total produced; steam consumed by prime movers and process steam consuming units; water supplied to boilers and pumped to processes; rate of generation, distribution and consumption of natural gas, coke oven gas, compressed air and the like; flow of fuel oil, brine, black liquor and so on; the Republic electrical type flow meter with remote reading instruments, as described in this book, is available.

MECHANICAL FLOW METERS—Bulletin No. 110

When it is desired to measure flow of steam, water, gas, air or oil for the same purposes as outlined above but where remote registration is not required, the Republic mechanical ring-balance meter described in this book is available. Since it may be built for differentials as low as 3 in. of water, it is ideal for low-pressure gas and air.

DRAFT AND PRESSURE INSTRUMENTS—Bulletin No. 801

Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic indicators and recorders, described in detail in this bulletin, are supplied in any desired combination for all ranges encountered in furnace operation.

RECORDING THERMOMETERS—Data Book No. 210

Measurements of temperature of flue gas, temperature in vats or tanks, pipe lines, refrigeration systems, ovens, kilns or ducts and so on, are vital in maintaining highest capacity and efficiency in power plant and process equipment. Republic recording thermometers for this service are described in this data book.

CO_2 METERS—Data Book No. 403

For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. The CO_2 meter is the most practical method of determining combustion efficiency. The construction and operation of the Republic CO_2 meter are described in detail in this book.

REGULATORS—Data Book No. S-13

Control of rate of flow of liquids and gases, level of liquids, speed of turbines, engines and motors and proportions between variable pressures and flows must be accurate if maximum plant efficiency is to be attained. These factors are controlled by operation of valves, dampers, rheostats, etc. For sensitive, fast, stable and powerful automatic control of these devices, the Republic-Smoot regulator has been developed. Its construction, operation and applications are described in this book.

AUTOMATIC COMBUSTION CONTROLS—Data Book No. S-21

Boilers must produce maximum steam output at maximum efficiency. That means constant steam pressure, maximum combustion efficiency, constant and correct furnace draft, desired load division among boilers. Republic-Smoot automatic combustion control systems are built for all sizes of boilers, all types of fuel firing and all load conditions, as described in this book, which includes detailed installation reports giving performance data on outstanding power plants.

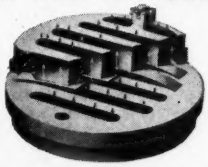
WRITE FOR THESE DATA BOOKS TODAY!

REPUBLIC FLOW METERS CO.
2224 Diversey Parkway, Chicago, Illinois

75 TO 3000 HORSEPOWER

HORIZONTAL DUPLEX MOTOR DRIVEN DIRECT CONNECTED AND BELTED

* **Only Worthington Compressors are Feather Valve equipped**



Simplest . . . lightest . . . most efficient valve yet devised for compressor service.

- Each valve consists of light strips of steel whose easy flexing permits passage of air
- No cushioning device required
- Strips seat by contact . . . not impact
- Unusually tight . . . due to flexibility of strips
- Minimum air friction . . . result, minimum power consumption due to flexibility, large lift area and tight seating
- Maximum accessibility . . . removable in five minutes . . . replaceable in eight
- Intake and discharge valves complete are interchangeable
- Negligible maintenance . . . nominal expense for valve strip renewal at long intervals

*Reg. U. S. Pat. Off.

Thousands of horsepower of Worthington compressors are now carrying vital parts of the United Nations' war production load.

Among the most important of their many noteworthy features is their FEATHER VALVE equipment . . . giving high volumetric efficiency and smooth, quiet operation, and contributing largely to the remarkable dependability, negligible maintenance and long operating life reported by prominent users in every field and under the most exacting conditions.

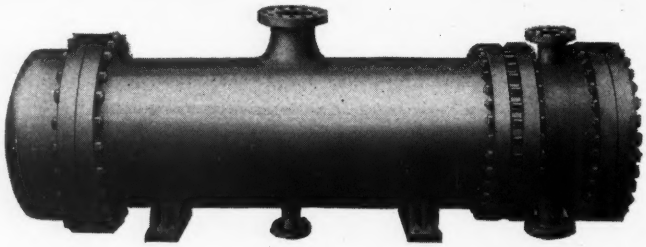
Both the Navy E and Army-Navy E Awards have been presented to Worthington for speed and excellence in production.

AC3-4

WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

FEED WATER HEATER EQUIPMENT

for High, Intermediate, or Low Pressure Service



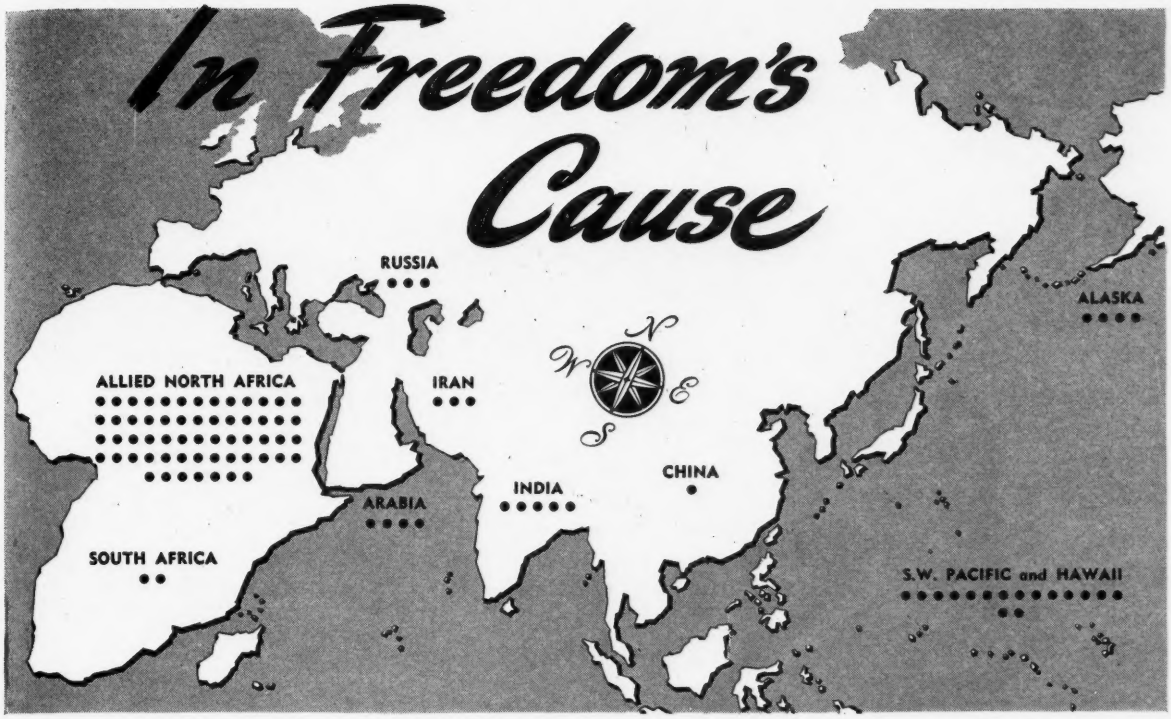
Lummus-designed and Lummus-built boiler feed water heaters are operating at pressures as high as 1200 pounds per square inch. Numerous Lummus units are in service in the intermediate and low pressure fields.

Lummus heat exchangers are available in all pressure ranges employed in modern power plants. Lummus heat exchanger equipment also includes Surface Condensers, Steam Jet Air Pumps, Fuel Oil Heaters, Lubrication Oil Coolers.

Lummus engineering personnel and construction facilities are available to public utilities and industrial power plants requiring equipment to meet specific conditions. Write for further information.

THE LUMMUS COMPANY
420 Lexington Ave., New York, N.Y.

LUMMUS



MARLEY COOLING TOWERS serve United Nations fighters and war industries on all fronts.

In addition to the great number of Marley Cooling Towers now speeding American war production, this map indicates recent Marley exports for service in the active war zones.

FACILITIES and "KNOW-HOW" to do the Job Speedily and Right

America's ability to expand its productive capacity so enormously and so quickly has saved the world from disaster . . . . by producing the *right* equipment to do each job that has to be done . . . . and *ahead of schedule.*

As an example, Marley's production at the start of 1943 is *triple* the same figure for 1942, which was *double* that for 1941 . . . . all on war-vital contracts.

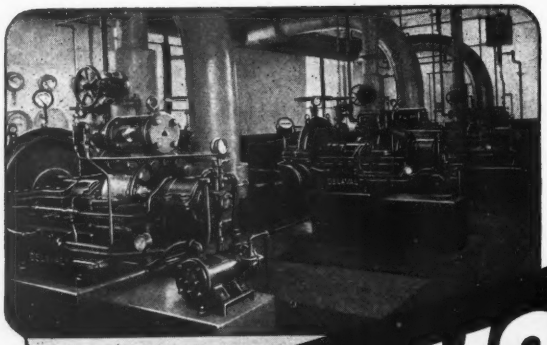
Because Marley had the facilities to swell output swiftly, plants producing essential war supplies have not suffered delay for want of water cooling equipment. And because Marley had the special knowledge and experience to engineer each installation specifically for its job, these plants save much in operating cost and maintenance man-hours.

These facilities and this specialized experience have proved to be a definite national asset, and Marley productive capacity is still ahead of demands!

1-43-A

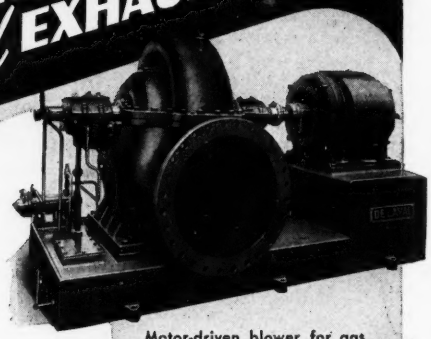
MARLEY COOLING TOWERS

Every MARLEY TOWER *is individually engineered by* THE MARLEY CO., INC. — KANSAS CITY, KANSAS



Three turbine-driven exhausters drawing gas from holders and forcing it through condensers, scrubbers and purifiers, light oil scrubbers and meters to storage holders; 2280 to 5700 cfm. each against a maximum of 60 in. water column. Hydraulic governors provide for quick adjustment of delivery and pressure.

DE LAVAL BLOWERS, COMPRESSORS and EXHAUSTERS

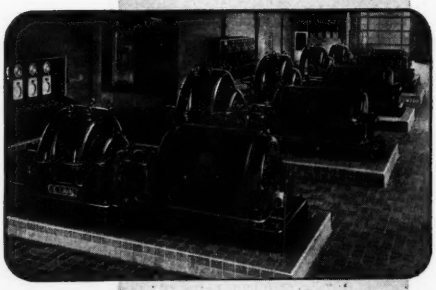


Motor-driven blower for gas plant; 26,200 cfm. against 54 in. water column.

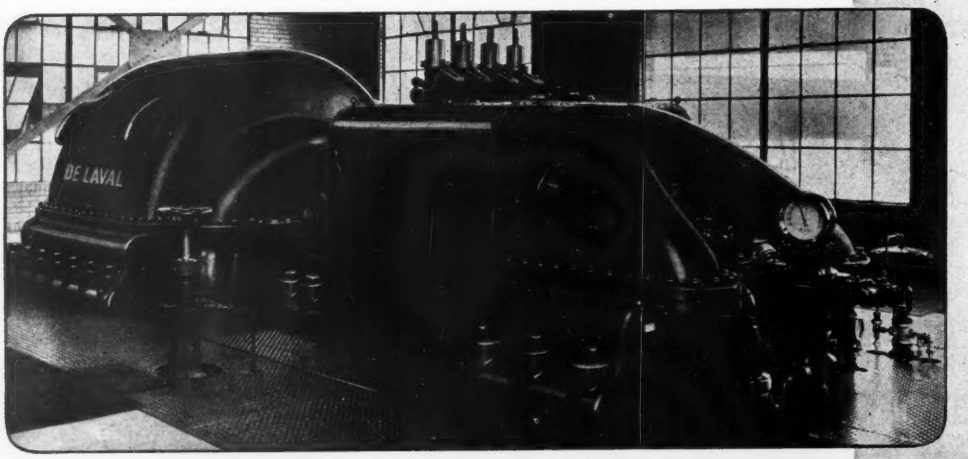
are built for all volumes and for pressures up to 100 psi. They embody scientific and sturdy design, which contribute to continuous service and long life. Modern De Laval steam turbines driving these compressors are adapted for high pressure, high temperature steam, with segregation of moisture in low pressure stages to increase efficiency and reduce erosion, and with perfected governing systems to hold constant pressure, constant volume or constant mass flow.

By using De Laval double helical speed-increasing gears, standard speed motors are combined with high speed blowers or compressors, thereby avoiding the complication and expense of a greater number of stages.

State requirements and ask for Catalog F-3821.



Compressors in activated sludge plant; 3 rated at 47,000 cfm. each, and 2 at 25,000 cfm. each; all against 7.4 psi.



Turbine-driven blast furnace blower; 85,000 cfm. against 30 psi.

DE LAVAL Steam Turbine Co.

TRENTON, N.J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

DEARBORN ENGINEER HELPS YOU TO . . .

reduce Overtime work

due to untimely shutdowns

Power plant engineers do not object to supervisory work that is necessary to keep boilers in full steaming condition. But . . . it's aggravating to work overtime on shutdowns which may be prevented. That's where the Dearborn Engineer comes in to help you!

His frequent calls, to insure maintenance of recommended conditions, extend the period of boiler operation. To serve you, he does not have to travel long distances because he lives and works in your district.

He knows local water characteristics, too. And, he helps you to solve your problems quickly.

The Dearborn laboratory provides him with the facilities to develop corrective measures and to design the system of control *especially for you.*

This service reduces costly repairs to a minimum and makes possible more continuous operation. He's a good man for you to know. Write to us . . . we'll gladly arrange for him to call.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave.
Chicago, Illinois

Dearborn Engineer does this for you . . .

(1) *Studies* your water and plant operating conditions.
(2) *Sends* samples of your water to main laboratory for analysis.
(3) *Recommends* proper chemical treatment and chemical control methods.
(4) *Supervises* installation of feeding equipment.
(5) *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
(6) *Calls* regularly to insure maintenance of recommended conditions.

Dearborn
TRADE MARK REGISTERED

WATER TREATMENT AND ENGINEERING SERVICE

PHOTO: OFFICE WAR INFORMATION

Another American Submarine soon to be in the thick of the fighting

Everyone reading of the thrilling activities of the American submarines especially in Japanese waters cannot praise our men too highly who operate these boats.

Submarines are needed in our plan of action. In the construction and operation of every submarine considerable Industrial Rubber Products are required. Quaker is playing an important part in supplying our Government with the vital rubber products to keep these sea-fighting machines in A-1 condition.

These and many other units of the Armed Forces, as well as plants on War orders, for which Quaker is producing, have the right of way. You would not want it otherwise.

Should your order with us seem a trifle long in reaching you, your patience is requested as we are doing everything possible to spread what permissible civilian products we can manufacture equitably among our many customers.

Everyone can help during these critical days. Use all your rubber products carefully. Take care of what you already have. When its usefulness is over, send to proper rubber collecting station to be turned in as scrap. No piece of rubber is too small; old overshoes, galoshes, piece of garden hose, discarded rubber mat, hot water bottle, or any article made of rubber.

Your scrap rubber with that of other local citizens will help materially to supply the necessary rubber products needed so badly to keep the War machine in fullest operation. Thanks for your help.

KEEP ON BUYING ***MORE WAR BONDS***

INDUSTRIAL RUBBER PRODUCTS

Rubber is scarce. There is no question about that. So is coffee, sugar, meat, butter, etc. But it is not patriotic to starve to death.

Neither is it patriotic to allow your plant to lose production for want of Industrial Rubber Products.

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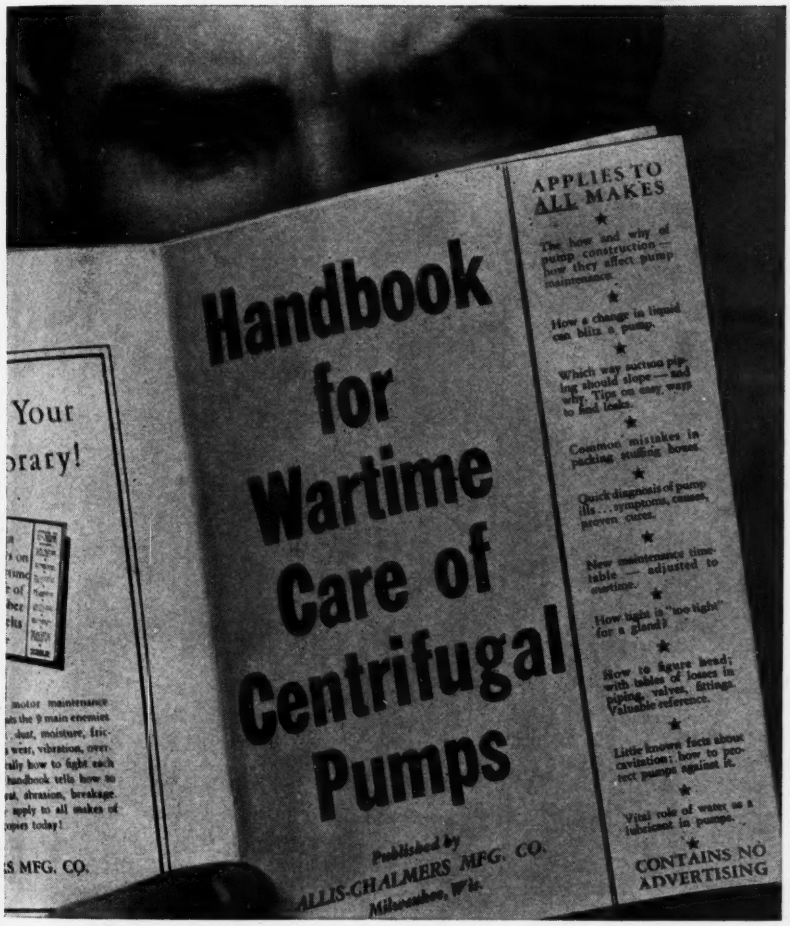

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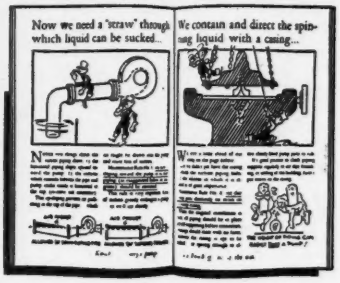

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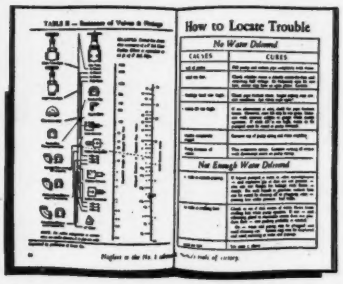

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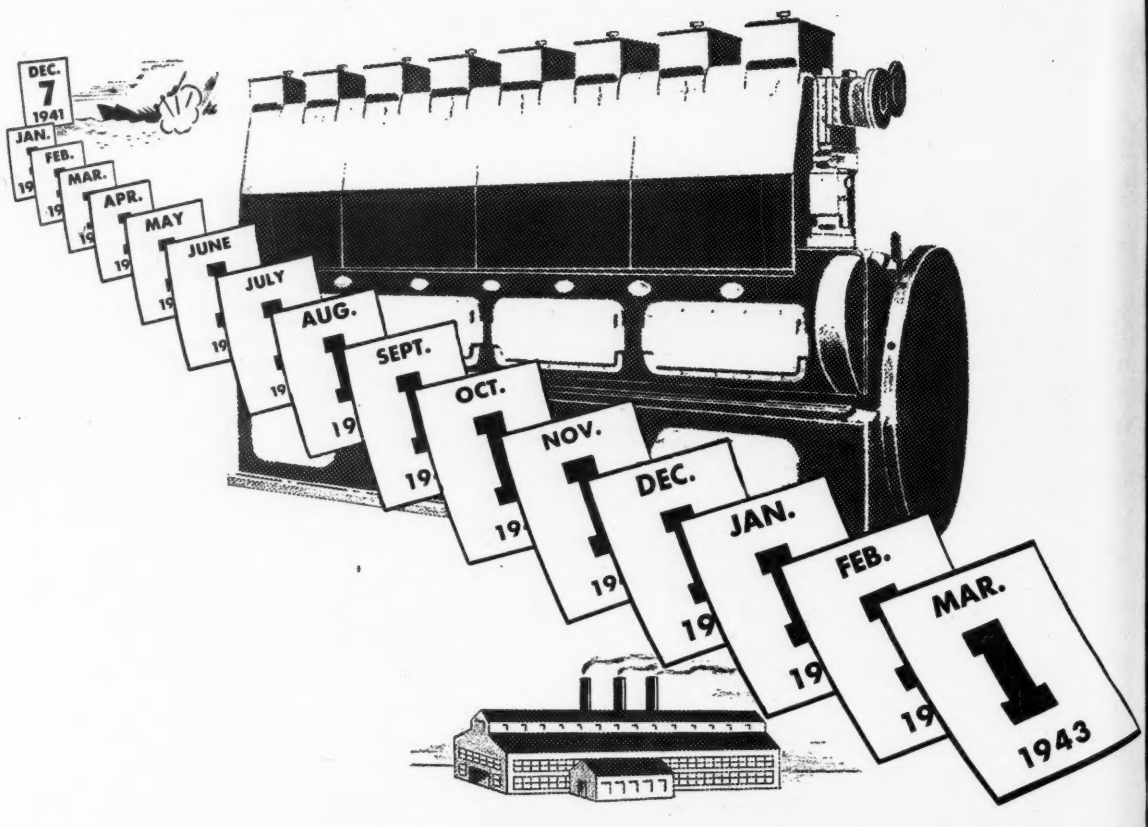

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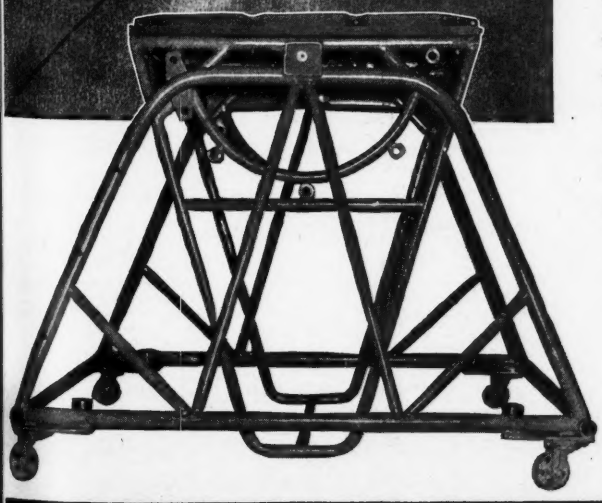

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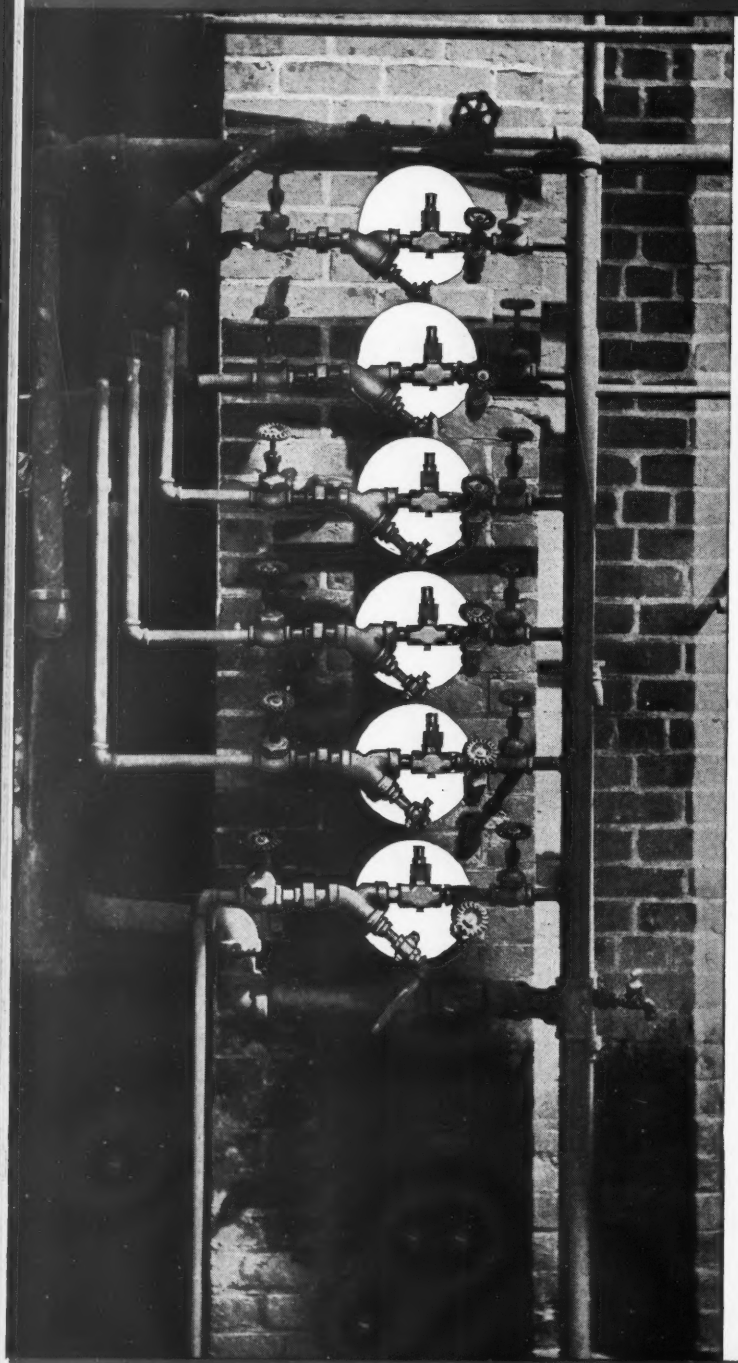

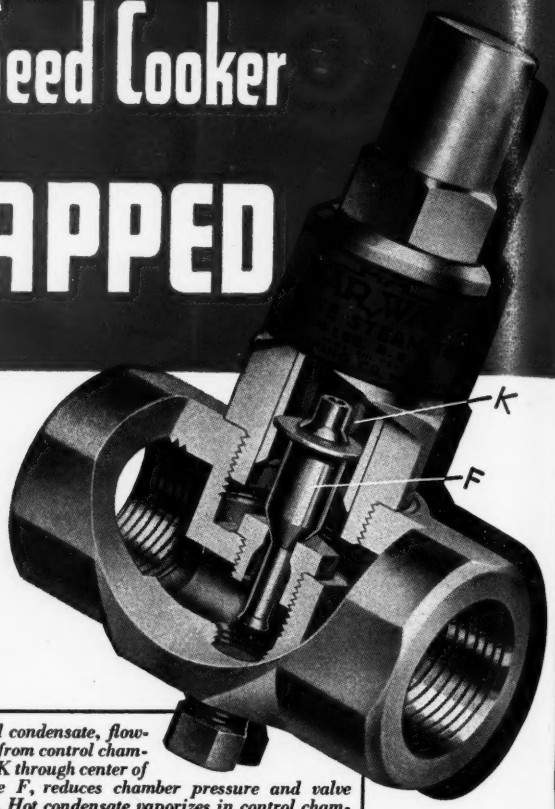

Cool condensate, flowing from control chamber K through center of valve F, reduces chamber pressure and valve lifts. Hot condensate vaporizes in control chamber, raising chamber pressure and closing valve.

SIX YARWAY Impulse Traps and Strainers handle the big job of draining the heating coils of this six-high continuous cooker—largest ever built—at Magnolia Provision Co., Houston, Texas.

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Have you investigated this trap about which users say,—"*saves fuel,*"—"*saves space,*"—"*easier and cheaper to install,*"—"*we like its flexibility on different pressures,*"—"*saves maintenance trouble and expense,*"—"*cheaper to replace with Yarways than to repair old-type traps,*" etc., etc.

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WHAT LEADERS SAY

How Revise the Patent System?

By ROBERT B. FISKE

THE Patent System was not created to enrich inventors, but to benefit the public by stimulating the invention, and promoting the development, of new and better processes and products. The public, through its lawmakers, has made a solemn promise that if an inventor will disclose to the public a new anl useful invention, he will have an opportunity to exclude others from its practice for a limited period—after which any member of the public will be free to use it.

From this standpoint; we do not find justification for the three bills for Patent Law revision sponsored by Thurman Arnold and Senators Bone, La Follette and O'Mahoney.

The provisions of these bills will demonstrate how Mr. Arnold's group has viewed a patent right as an inherent challenge to the Anti-Trust Laws, which must be removed, not by applying the Anti-Trust Laws to the exercise of that right (as in the case of other rights), but by emasculating the right itself. Thus we would have the paradox of promising an inventor a right to exclude others if he will contribute something new and useful to society and, after he has made his contribution, reminding him that his right to exclude is only a "reasonable" right to exclude, which he can exercise only if he can prove its validity in court over the opposition of the government which granted it to him.

Unless the Patent Law stimulates not only the invention, but also its development to the point where the public can get better and cheaper goods, the risk capital for such development will not come forward, whether the invention comes from the individual genius or the research laboratory.

In April, 1933, President Roosevelt appointed the Science Advisory Board, which established a "Committee on the Relation of the Patent System to the Stimulation of New Industries," under the Chairmanship of Dr. Vannevar Bush. It submitted a report in April, 1935, suggesting certain changes in the Patent Law. Most of the suggestions we would propose parallel recommendations contained in that report.

We have placed first on our list a suggestion that we borrow some part of the opposition procedure embodied in the Patent Systems of other countries, with whatever changes are necessary to adapt it to our economic structure. The Science Advisory Board has proposed that before patents are issued, the claims be published and the public afforded an opportunity to present evidence of prior art which would afford good cause for refusing the patent. This evidence would be treated by the Patent Office in its regular *ex parte* proceeding. Our suggestion would go further, for we would afford anyone an opportunity to present evidence of prior art, public use or other reasons for denying the patent, to be answered by the patent applicant and to be ruled upon by the Patent Office.

If this procedure were followed, the Patent Office would have the benefit of painstaking searches made by specialists in their fields over many years, more comprehensive than any studies which its own over-burdened Examiners could possibly make. The Patent Office would necessarily exact a higher standard of invention as the price of a patent grant; and the public would have a hearing at the source.

A patent which issued after the public had been so notified and afforded an opportunity to appear in opposition would obviously command a higher "presumption of validity" from the courts than those which now issue without the public being heard; and protracted, uncertain and expensive litigation to establish the validity of issued patents would seldom be necessary.

The second suggestion would limit the life of a patent to 20 yr. from the date of filing the application. Clever attorneys have been able to keep an application in the Patent Office for years before its issuance; and this practice has met such condemnation that in some cases courts have invalidated the patents as a result. If the patent rights dated from the date of filing the application, as in England, there would be no incentive for such delay.

The third suggestion advocates a system of taxation for the maintenance of patents, as in the case of most important foreign countries. This is one of the recommendations of the Science Advisory Board. At the present time, innumerable patents of slight intrinsic value remain upon the records; and much prospective research and development which would benefit the public is discouraged by their mere existence, however doubtful their validity or utility. If the owners of these patents were required to pay a graduated tax for their maintenance, small in the early years and gradually increasing, the initial costs in the Patent Office might be reduced, and many useless and obstructive patents would be allowed to lapse.

The fourth suggestion proposes the creation of a single Court of Patent Appeals in place of the present system of appeals to the United States Circuit Courts of Appeal. This reform was recommended by Commissioner of Patents Coe and approved by the Temporary National Economic Committee and the Science Advisory Board.

With the creation of such a court, dedicated to the full time administration of the Patent Law and staffed by judges carefully selected for the purpose, patent lawyers would no longer comb the country for a court of particular sympathies or prejudices, nor start harassing litigation in several Districts for the purpose of forcing settlements. The judges, detached from other issues, would become students of patents and the Patent Law; and gradually the country would be provided with a comprehensive, cohesive guide to patent problems, in the place of the present chaos of conflicting and irreconcilable decisions.

The last suggestion, which is similar in principle to a recommendation of the Science Advisory Board, would permit the Federal District Courts to call upon technical advisors for aid in determining complicated technical issues of fact. At present, District Court Judges must rely upon experts employed by the litigants and the self-serving testimony which, of necessity, they present.

ROBERT B. FISKE, assistant to the vice-president of American Cyanamid Co., deals with general administrative problems and particularly with patent policies. He was born in Auburndale, Mass., in 1900, was graduated from Yale College in 1924 and from Yale Law School in 1926. He was editor of Yale Law Journal in 1926. During the latter part of World War I he served in the U. S. Naval Reserve Force, later went to sea in the U. S. Merchant Marine for over a year and then worked for American Hawaiian Steamship Co. After graduation from law school, he engaged in general law practice with Root, Clark, Buckner & Ballantine of New York City. As one of the representatives of this firm, he spent over a year in Europe. In 1931 he spent some time in Chile in connection with the organization of Cosach (Chilean Nitrate Co.) and followed this with 9 mo. service as a member of the legal staff of the Reconstruction Finance Corp. He joined the legal department of American Cyanamid Co. in January, 1934, became assistant secretary in April, 1939, and entered upon his present position in May, 1939. Mr. Fiske's comments on the patent situation are extracted from a recently-published paper on the subject of The Public's Interest in the Revision of the Patent System.

BEHIND THE AMMUNITION

IT WAS said that World War I was fought in thousandths of an inch. If that was so, it must be said that this war—World War II—is being fought in tenths of thousandths of an inch. During World War I, mass production, while already highly developed in certain lines was still in its infancy compared to present standards. Mass production is based on accuracy; each of hundreds of thousands of similar parts must match perfectly and be interchangeable. Any slight variation in size of a part causes stoppage and trouble—no end of trouble sometimes. A jammed machine gun due to improperly sized ammunition may lose valuable lives and battles. ¶ To maintain the accuracy of a "tenth" or a "half tenth" on the precision fighting equipment being produced at such enormous rates throughout the country, the gage blocks used in setting machine tools and in checking the size of manufactured products are of prime importance. They represent the utmost in accuracy. In the photograph above, we see a young woman worker checking a 4-in. micrometer with a standard set of gage blocks. This is a set of Doall master gage blocks made by the Savage Tool Co., Savage, Minn. It consists of 81 blocks ranging in length from 0.050 in. to 4.00 in. They are produced in three grades of accuracy. Grade AA with an accuracy of 0.000002, Grade A with an accuracy of 0.000004 in. and Grade B with an accuracy of 0.000008 in. Each gage block in addition to being extremely accurate in length has its measuring surface lapped to a flatness of less than the quarter wave length of light and is produced with a mirror finish. These two factors enable the blocks to be wrung together in combination, enabling the user to secure practically any dimension in steps of 0.0001 in. from 0.1000 in. to 12.00 in. ¶ Precision optical measuring instruments are used to check the accuracy of every gage block produced and this equipment is also available to users for rechecking their master gage blocks after they have served their purpose

WITH THE EDITORS

◆ **A CHALLENGE** . . . An Opportunity—If manpower shortage has not already been felt in your power plant there are many indications that it will be soon unless steps are being taken or have been taken to increase greatly the salaries and other advantages to capable operating engineers employed in the plant.

The shortage to which we refer is not that which exists among the unskilled labor class of employes or the boys brought in for training in manual work. Concern now is with those men who, through years of experience, have become skilled repair and maintenance men, firemen, electricians, pipefitters and welders, machinists, and men who have made a profession out of power plant engineering by the application of such sciences as mathematics, physics, chemistry, thermodynamics and electricity to the economical production of power.

Many such men have been drafted into the armed forces, others have chosen to serve the country voluntarily, still others have taken better paying jobs in war industry plants. Without doubt the vast majority of the power plant operating engineers of the country, mostly in the older brackets, are still working loyally for their employers of recent years even though considerable advancement in salaries could have been secured by changing to another employer hard pressed for men with their qualifications.

The existing critical situation has been brought to immediate attention by information coming from Government and other sources. For instance, announcement is made by the War Manpower Commission that short, free, training courses will be conducted under Government supervision which will fit youths and adults for positions in war industries including engineering, science and management.

Unprecedented opportunities are being offered by the American Merchant Marine to engineers who will go to sea. Special courses have been developed for refreshing men whose marine licenses have expired, for men whose licenses are limited, and for stationary engineers without previous experience.

In a recent radio address Commissioner McNutt indicated his opposition to drafting men in vital war connected jobs when he stated, "We must keep communications going, supply light, heat, water, and power, and do the thousand and one things needed to keep our home economy functioning. We could not possibly do away with all civilian activity, even if anyone were foolish enough to wish to."

Word also comes from Washington that able bodied men between the ages of 18 and 38 yr. must get jobs in essential industries or be subject to draft.

The professional type of operating engineer is the product of years of experience in the field of power generation. In many instances an engineer has found it necessary to change his position in order to gain experience with types of equipment not installed in the plant where he was working. Too often the engineer has grown up in a plant without due salary recognition of his increasing knowledge of the equipment and functioning of the whole power generating process.

Now comes a period in which new war plants are being built at a rapid rate, too fast to permit training recruits from outside the field to take charge of operation. The result, of course, is the hiring of competent, trained engineers from the staffs of power plants already in operation. Some of those positions which have been vacated can be filled by understudies with advancements all down the line.

In essential industries, those holding jobs in the power plants will no doubt be considered draft exempt for some time, but men of draft age capable of doing necessary work who are employed in any of the non-essential industries are urged by the Manpower Commission to make the change to an essential industry if they wish to retain their industrial deferment classification. The Government will assist those making application for such a change to become suitably located.

Power plant engineering is fascinating work for many men with mechanical aptitudes. So fascinating, in fact, that wages seldom take first place in consideration of power plant employment. Among the advantages are steady, continuous work, reasonably regular hours, numerous opportunities to exercise ingenuity and inventive genius, and continuous education in applied sciences. In short he sees an opportunity to fulfill a mission in life. When social conditions, however, force such men to consider salary as a paramount issue, the power plant engineer will be found to possess many talents any one of which can quickly be developed into a money making trade. Employers who wish to keep their power plants running efficiently and without breakdown will see to it that these trained engineers who are putting science to work are given employment opportunities that are not available to them in other occupations.

Thus we have in our present day conditions a challenge to the employer and an opportunity for power plant engineers.

◆ **USE IT UP** . . . Wear It Out—Make It Do—That's the power plant engineer's motto these days. He doesn't like the procedure, for it doesn't always lead to highest economy, means much extra work and involves many headaches. But it must be done in wartime to keep things going. And frequently there is no other choice, as every reader will testify.

But with all its advantages as a wartime procedure, it is leading the power industry into a situation that must sooner or later be faced. Because we must do it, we are wearing out our power plant equipment at a much more rapid rate than ever before.

Of course the various governmental and private agencies concerned with power are not just sitting back and ignoring this factor. Therefore, since power is the basis of the entire war production system, there is little chance that the power industry as a whole will ever get close to a dangerous point of complete wear-out. Long before that point is approached, the weak points will have to be strengthened one by one as they appear and analyzed carefully to make sure that too many strains do not develop in too many places all at once.

We were pointing with pride in the February issue to the fact that the Power Industry Meets All War Demands in 1942. Taking the country as a whole, that is certainly true. Total utility capacity and reserves are adequate for the 1943 demands. But at the same time, many utility engineers do not like to operate with their present low margins. An engineer in one vital section of the country told us that, by any normal utility standards, his region is below rock bottom on reserve capacity. He says he has seen more of his capacity go off the line in one night, due to breakdowns, than the total reserve capacity of his region. . Yet the F.P.C. men, commiserating with him in his plight, still insist that he is far better off than many sections of the country!

One utility is operating an old low-pressure turbine in which they know one of the wheels is cracked. They must keep her rolling to turn out the kilowatt-hours. The operators walk past the unit on tip-toe. But is a soldier safe in battle—a sailor safe on convoy duty? We've got to take chances now that we wouldn't consider in peacetime.

Every kind of kettle that will make steam must make what it can. Two plants we know of are installing marine boilers, some of which must be 20 or 25 yr. old, because nothing else is available—and that means literally nothing else. There is much interest in methods of cleaning equipment by chemical methods, especially turbines and boilers, to lessen outage time. Hotel engineers complain that they can't get maintenance supplies, are told they are non-essential industries, yet their rooms are filled with Army and Navy officers on official business. And so it goes.

A favorite indoor sport these days is calculating the tremendous amount of replacement that will be needed in our process and machine production facilities when this war is over because we are running the everlasting daylights out of it. But the power industry's equipment, which drives all the other equipment, may be wearing out even faster. Sooner than we think, we may have to stop and rehabilitate it.

We must take care not to get into the situation of the late Don Marquis, who (so he said) frequently had to stop work on his great opus, The Almost Perfect State, to write the works of reference to which he could refer in one-line footnotes!

POWER National

Fig. 1. Looking down on the turbine floor and main switchboard

AMONG the many properties maintained by the Lone Star Cement Corp. is the very modern plant of cia. Nacional de Cimento Portland (National Portland Cement Co.) at Guaxindiba-Nichteroy, Brazil, South America. This plant is situated on the Gamba River (Rio Gamba) about 20 mi. from Nichteroy, across the bay from the city of Rio de Janeiro. Built in 1932 with an extension constructed in 1934-'35, and further enlarged in 1941-'42 this cement plant is of the most modern design and is completely electrified. It is representative of the best practice in the Western Hemisphere.

Until 1939 electric power for this mill was furnished by the Electric Bond & Share Co.'s subsidiary, Companhia Brasilera De Electrica. Due to the increasing load on the power company's system, however, it had become apparent even before that time that the amount of power available for the mill would be limited and that the mill would be obliged to generate its own electric power.

The design and construction of a power plant for this mill involved problems quite different from those obtaining with a similar plant in the United States. Rio de Janeiro, to begin with, is in a tropical region where the bay and river water frequently has a temperature of 95 deg. F. With such condenser circulating water temperatures it is obvious that the design of an economical plant requires careful attention. Fuel constitutes another problem. While there are a considerable number of coal mines in Brazil, the quality of the coal is undesirable as far as combustion characteristics are concerned.

For a modern industrial steam generating unit such as was proposed it was felt that a more efficient medium than local coal should be used as fuel. Oil, therefore, was decided upon, but provision was made in the design so that coal can be used if conditions changed in regard to the availability of fuel oil. The amount of fuel oil produced in Brazil is negligible, but several of the neighboring countries produce large amounts. Most of the oil used at the mill is imported from Venezuela.

The cement kilns in the mill had been fired with fuel oil over a period of years with satisfactory results. With this experience at hand and after detailed study of other possible fuels, it was finally decided that oil would be used as fuel in the power plant.

As might be expected where oil has to be shipped from other countries, the fuel oil cost per barrel is quite high. This fact, coupled with the prevailing high condensing water temperature made it imperative to make use of a high-pressure and temperature plant. Only with such a plant could the desirable economy be obtained.

The decision to build such a high - pressure high - temperature plant at this location brought forth problems that would not arise in our own country. It will be obvious that there are few such plants in Brazil and experienced operating personnel is almost impossible to obtain locally. Hence, the plant had to be designed as simply and as completely automatic as possible, and insofar as erection was concerned all parts had to be shipped as completely assembled as possible.

General Design

The power plant is designed on the unit system, that is, one boiler and its auxiliaries serves a turbine and its associated equipment. Normally the plant is operated in this way, but provision is made so that in the event of boiler failure, the remaining boiler can be made to carry the two turbines. Each generating unit is rated at 3750 kv-a. The steam generating capacity of each boiler is sufficient to handle an electrical load of 6000 kw.

The power plant was designed and constructed by the Engineering Department of the Lone Star Cement Corp. with the engineering firm of Burns & Roe of New York acting as consulting and advisory engineers.

Several heat balance studies were made in order to arrive at proper values of pressure and tem-

for the Portland Cement Co. of Brazil

This is a description of a South American industrial power plant, designed in the United States and constructed entirely of equipment manufactured in the U.S. Built in competition with that of European interests, this plant is representative of the best practice in the Western Hemisphere. With a heat rate of less than 15,000 B.t.u. per kw-hr., this plant is more carefully and completely designed than many central stations of much larger capacity. It consists of two 57,000 lb. per hr. boilers and two 3750 kv-a., 2400-v., 3-phase, 60-cycle electric generating units

perature of the steam at the turbine throttles and extraction points. The turbine throttle conditions were finally set at 650 lb. gage pressure and a total steam temperature of 825 deg. F. Four-point extraction, condensing turbines were selected.

Since the condenser circulating water temperature approaches 95 deg. F. during the summer months it was necessary to select a surface condenser capable of operating under a smaller terminal difference than that of a unit of conventional design. Under full load the condenser was designed to maintain a vacuum of 27.75 in. Hg. with 95 deg. F. cooling water.

The condensers were built by the Allis-Chalmers Mfg. Co. They are 60 in. in diameter with tubes 16 ft. 3 in. long, and having a total of 3530 sq. ft. of condensing surface. They are horizontal, single-pass units, with 963—7/8-in. diam. tubes in each unit. Under full load each condenser requires approximately 9970 gal. of cooling water per minute.

Since the circulating water is obtained from the bay and the Rio Gamba, the water is frequently on the brackish side. Moreover in a tropical country such as Brazil, marine growth is very active and great care must be exercised to prevent the accumulation of these growths in the condenser tubes. Algae life is abundant in the neighboring areas. To prevent these organisms from propagating in the circulating water lines, and condensers, calcium hypochlorite was tried but found ineffective. The plant changed to liquid chlorine which is introduced into the main circulating water line. This method proved very successful.

The two turbine-generating units installed in the plant are General Electric Co. machines rated at 3750 kv-a., 0.8 p.f., 2400 v., 3-phase, 60 cycles. The turbines have 16 stages with extraction points at the 2nd, 6th, 9th and 13th stages. At full loads, the corresponding absolute pressures are 373, 142.5, 43 and 7.7 psi respectively.

With the proper use of these bleed points and the heating system employed, relatively high feedwater temperatures can be obtained with corresponding economies in fuel. The calculated net station heat rate at 3750 kv-a. is 14,960 B.t.u. per kw-hr. This value includes all station auxiliary power, radiation losses, drip and boiler blowdown losses and electrical losses up to the switchboard. The calculated turbine heat rate at full load is 11,545 B.t.u. per kw-hr.

The steam and water piping connections are indicated in Fig. 3 which shows the complete layout for one boiler and one turbine. A deaerating heater is provided to receive bleed steam from the 9th stage. All other feedwater heaters are of the closed type, shell and tube design. The closed extraction heaters are fitted with an additional small submerged heat exchanger or drain cooler. These cool the drips from the extraction heaters to within 5 deg. F. of the condensate temperature leaving the drain coolers. When supplied with sufficient bleed steam, these closed extraction heaters are designed to heat the condensate to within 5 deg. F. of the saturated steam temperature of the particular bleed stage involved.

Each drain cooler is fitted with a Stets Co. continuous drainer which effectively maintains these

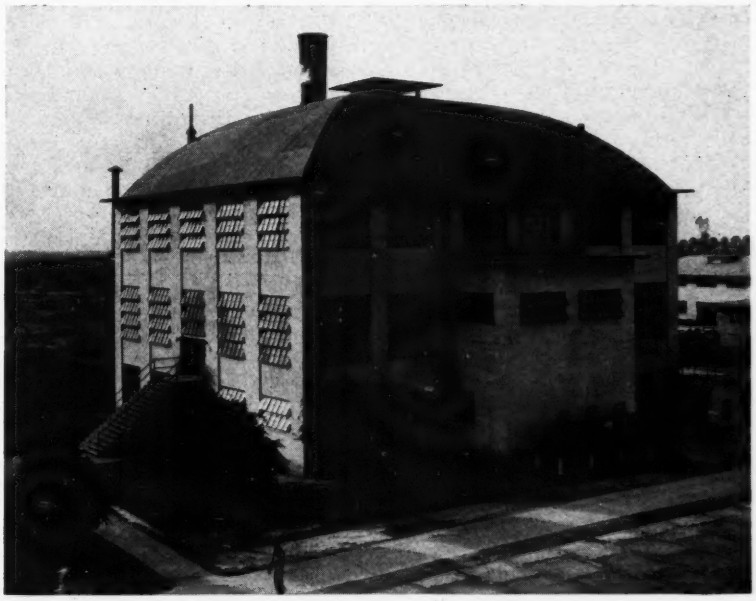

Fig. 2. Exterior view of the power plant showing the monolithic concrete roof

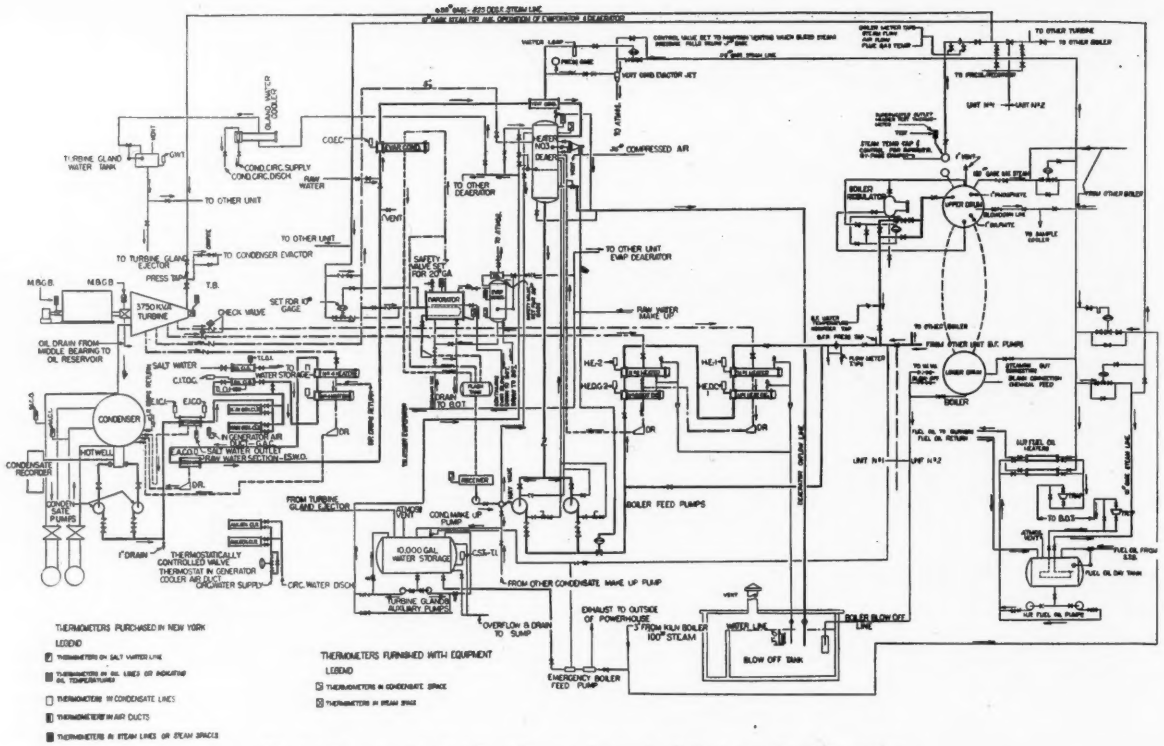

Fig. 3. Steam and water flow diagram for each of the two units of the station

units submerged and progressively passes the drips to the next lower temperature heater. This is also shown on the flow diagram. It was the opinion of the designers that the drainers were sturdy devices and preferable to drip pumps which have been used in other similar systems.

Each deaerating heater receives condensate from several high pressure steam traps and the condenser hotwell together with drips from the 2nd and 6th stage turbine extraction heaters. It also receives evaporated make-up water which supplies such deficiencies as are created by steam and condensate losses.

As shown on the flow diagram, the direct contact deaerating heater is supplied with extraction steam from the 9th stage of the turbine, the volume of extracted steam being sufficient to heat the condensate to the saturated steam temperature. Condensible vapors and non-condensible gases pass up through the vent condenser on top of the deaerator. The cooler, incoming condensate condenses the vapors which returns to the deaerator while the non-condensible gases are released to the atmosphere.

The deaerators, furthermore, are equipped with automatic steam jet air ejectors to discharge non-condensible gases to the atmosphere at such times as when the 9th stage extraction steam pressure may be below 15 lb. abs. The deaerators will maintain an oxygen content in the water of less than 0.03 c.c. per liter.

To guard against sub-atmospheric pressures in the deaerators, they are equipped with 10 lb. (gage) live steam connections. In the event that the extraction pressure falls below 10 lb. (gage) the live steam takes preference and heating and deaeration will be maintained at this value of pressure. The station loses the economy of the 9th stage extraction steam only at such low loads as would cause this system to function. Water level in the deaerating heater is controlled automatically by float control. Due to the use of steam for gland sealing and because of other losses, the condensate level in the heater drops continually. The float control permits additional condensate to enter as it is needed.

To provide an ample quantity of pure water at all times, a 10,000 gal. storage tank forms a part of the system. This tank receives its supply from the evaporators. Since there are two complete evaporating plants each of these discharges into this tank.

With a closed system such as the one under consideration, the amount of make-up water required is very small. The total make-up requirements are in the neighborhood of 0.6 per cent of the total amount of steam used. All fresh water available in the vicinity of the mill comes from wells. This water has a varied mineral content and since the high ratings at which the boilers are run require water of a high degree of purity, all water used is evaporated.

Each evaporator system consists of a deaerating preheater, an evaporator, evaporator condenser, and a flash tank. Also provided is a condensate receiver and a drip pump to elevate the condensate to the deaerator or on to the 10,000 gal. storage tank already mentioned.

This is a more elaborate system of feedwater preparation than is usually found in industrial power plants, but its use here can easily be justified. It is felt that corrosion and boiler scaling troubles can be overcome to a great extent if the make-up water is maintained in a pure state. Moreover, boiler blowdown losses can be materially reduced with consequent fuel saving, if the boiler water is pure. Finally, pure water results in cleaner steam which reflects itself in lower tur-

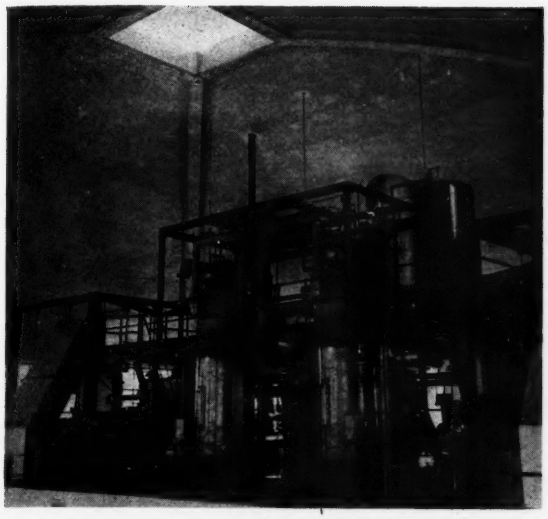

Fig. 4. The deaerators and gland water tanks

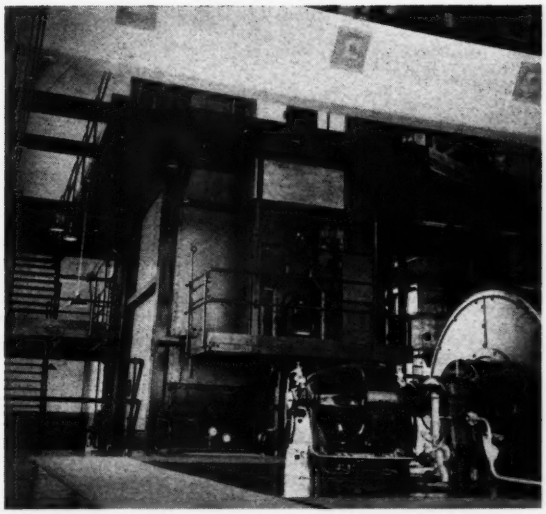

Fig. 5. No. 2 boiler from the turbine room floor

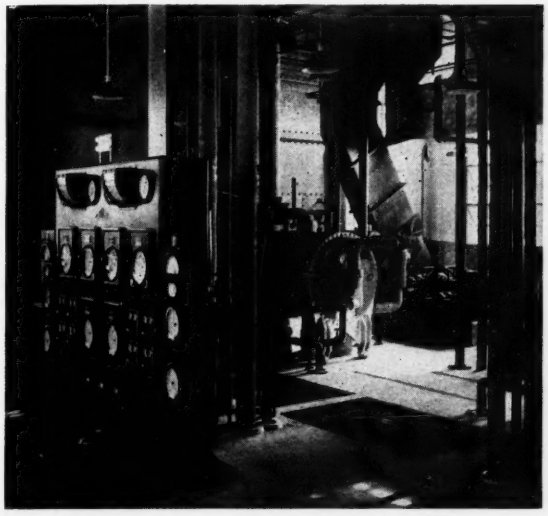

Fig. 6. Boiler floor control board and No. 2 auxiliaries

Fig. 7. Turbine floor facing East

Fig. 8. Firing aisle facing East

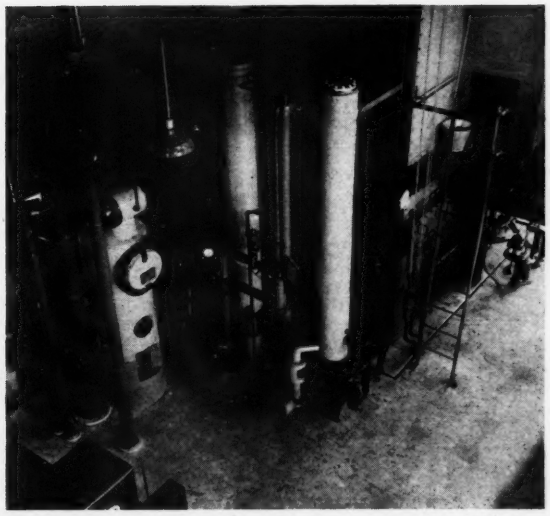

Fig. 9. The fuel oil heaters

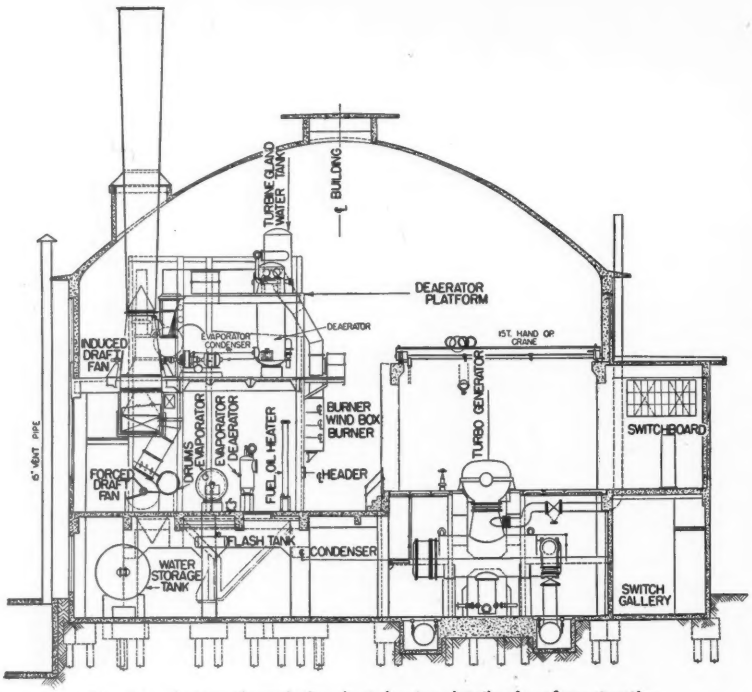

Fig. 10. Section through the plant showing details of roof construction

bine maintenance costs and fewer outages.

The evaporator receives bleed steam from the 9th extraction stage of the turbine. A portion of the evaporator vapor is delivered to a direct contact deaerating preheater which heats the incoming raw water before the latter enters the evaporator shell. The preheater, as will be noted on the flow diagram, has a vent condenser which permits venting of the non-condensible gases. At the same time it recovers the heat in those gases and vapors. The incoming raw make-up water is the cooling medium in the vent condenser.

The evaporator vapor flows to its condenser where it is cooled and condensed by the condensate from the main condenser hotwell. The evaporate then flows to a flash tank in which it mixes with the condensed steam from the heating coils of the evaporator. The flash tank discharges to a receiver on the drip pumps. The latter delivers the water either to the deaerating feedwater heater or to the 10,000 gal. storage tank.

The evaporator is equipped with a continuous blow-down system so that the concentration of the brine can be controlled. A predetermined maximum concentration results in cleaner steam, less carryover and less maintenance. As in the case of the deaerating heater, the evaporator is fitted with an auxiliary automatic live steam supply, so arranged that the evaporator may be started up at any time even though the turbines may be shut down. This live steam supply also comes into action automatically if the extraction steam pressure drops below 25 psi abs.

Each turbine is provided with gland steam jet condensers to condense such steam as is required for the high-pressure and low-pressure seals. A steam seal regulator insures that a predetermined amount of 50 lb. (gage) steam is supplied to the seals. The condensed steam and cooling condensate return to the 10,000 gal. storage tank. To prevent the building up of high temperatures in the storage tank, two gland water coolers are installed. These coolers use brackish water for cooling. The same brackish water is also the coolant for the main condensers.

The service condensate pumps take their supply from the 10,000 gal. tank, pumping it through the gland water coolers and then elevating it to a gland condensate tank. This tank is under float control. Cooled condensate flows by gravity down to the turbine gland steam-jet condensers. With this system it is possible to maintain a fairly constant liquid pressure on the gland steam jet condensers regardless of variation in pump pressure.

The main condensers are equipped with 2-stage twin element steam jet air ejectors, each

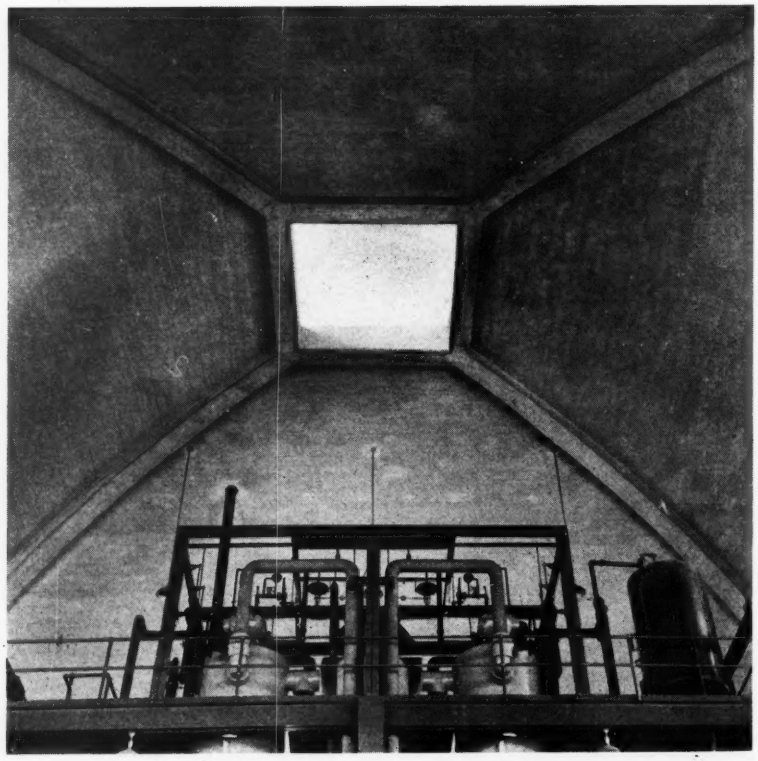

Fig. 11. A view looking up showing the dome roof ventilator

ejector element requiring approximately 180 lb. of steam per hr. These units are designed for heating of the condensate by condensing the steam supplied to them. By this method a large portion of the heat in the steam is recovered.

The inter and after condensers of the steam jet air pumps also have raw water sections which can be used if a fault should occur to the condensate section. Ordinarily only one jet on each stage is needed, but when excessive leakage of air occurs in the main condenser both jets are used.

Condenser Arrangement

The condensate from the inter-condenser drains through a conventional loop into a header connecting the main condenser and its hotwell. The after-condenser drains through a trap into this header, the non-condensible gases being vented to the atmosphere. The purpose of this arrangement is to provide a free flow of vapor between the condenser deaerating hotwell and the main condenser tube surface. This not only aids in the removal of condensible vapors and non-condensible gases from the hotwell but has an advantage in keeping the condenser hotwell pumps running free from suction cavitation.

The electric generators are provided with a condensate and raw water air cooler, by means of which part of the electrical heat losses are recovered in the condensate. In the event that the temperature of the condensate rises above a safe value, however, the raw water section automatically goes into service. The lubricating oil coolers are likewise arranged so that oil may be cooled either by raw water or condensate.

The arrangement of these various coolers was governed by the service they perform. It will be noted that the inter-condenser of the steam jet air ejector is located directly after the main condenser hotwell pump. This is essential in maintaining a high vacuum. Since the condensate temperature governs the inter-condenser drip temperature and also the non-condensible gas temperature and volume, the cooler the inter-condenser condensate is, the better the chance of maintaining the steam jet air ejector at its maximum capacity.

The power plant occupies a separate building at the N.W. corner of the cement mill property. As might be expected this building, as are all the other buildings comprising the property, is of the most modern and highly developed reinforced concrete type of construction. Because of the scarcity of steel in South America, and the relative abundance of cement, concrete construction is in many ways more highly developed than it is in this country. Note the accompanying photographs of the station. Note the interesting monolithic arched roof construction—a sort of groined ceiling design providing an interior that is entirely free of supporting members of any kind. Of particular interest is the extreme thinness of the roof section, varying from 4 to 6 in.

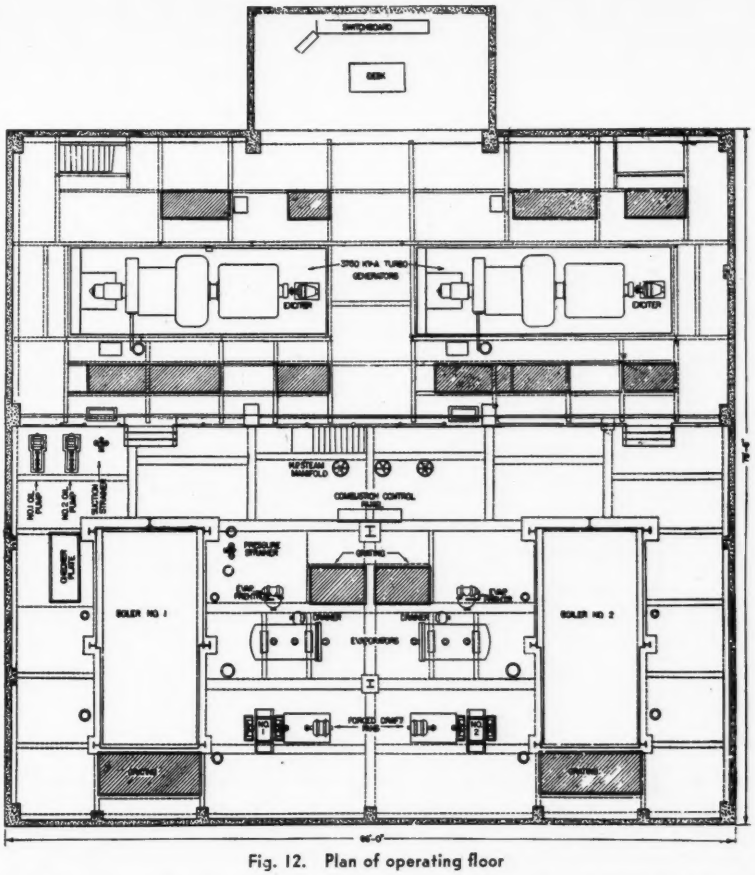

Fig. 12. Plan of operating floor

The walls and floors as well as the stairways, even the crane supports, are all of concrete. The interesting feature of all this construction is that it is anything but clumsy. It is neat and to a large extent graceful. The entire absence of supporting members in the upper part of the building provides an atmosphere of spaciousness that is startling to one not accustomed to this type of construction. A single protected opening in the roof provides an abundance of ventilation and light.

As will be noted from the cross section, Fig. 12 and the photographs, there is no dividing wall between the boilers and the electric generating equipment. The turbine operating floor is a few steps higher than the boiler operating floor, but the equipment is all in one large room. One crane rail is supported by a line of concrete columns which marks one boundary of the generator floor.

Details of Boiler Plant

The arrangement of the equipment is symmetrical with one boiler and turbine on each side of the building and with the Thermix stack in the center between the two boilers. The main condensers are set transverse to the generator axis, which permitted a symmetrical arrangement of circulating water inlet and outlet lines.

The whole design is simple, logical and functional. Although no special effort was made to produce a show plant, it is in many ways as attractive a power station as one can find anywhere.

With this general picture of the plant as a whole in mind, attention is now directed to the steam gen-

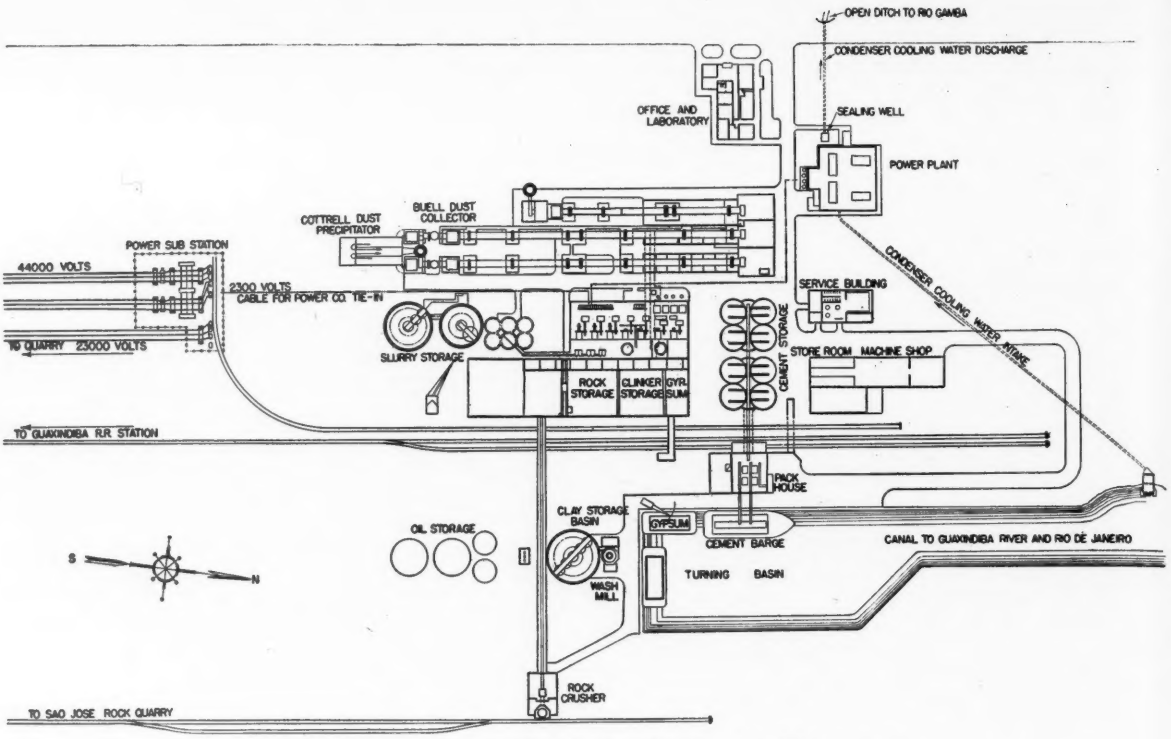

Fig. 13. Plot plan of the entire plant showing relative location of the power plant

erating part of the plant. The two boilers are Combustion Engineering Co. bent tube, integral furnace type units built to maintain a turbine throttle pressure at 650 psi (gage) and 825 deg. F. total temperature. This corresponds to a superheat of 347 deg. F. Each unit has a capacity of 57,000 lb. of steam per hr.

To limit the steam temperature to a maximum of 825 deg. F. at high loads, each steam generator is provided with superheater by-pass dampers, controlled automatically. The performance of these by-pass dampers is shown graphically in the curves, Fig 14.

Boiler furnace walls are completely water cooled, using bare tubes. The furnace bottom is also water cooled, the tubes being arranged in the form of a screen. From the boiler outlet, the combustion gases are drawn through a Ljungstrom air heater by an induced draft fan and then discharged to the atmosphere by a Thermix stack.

Each boiler has its own forced and induced draft fan and air preheater. The Thermix stack, however, is common to both boilers. Each air heater is capable of heating the air for combustion from 80 deg. F. to 500 deg. F. when the boilers are delivering 57,000 lb. of steam per hr. Excess air is approximately 20 per cent. Although oil is used as fuel, it was clear that better combustion would be obtained with preheated air. Also if the plant should change to the use of pulverized coal at some later time the air preheaters would be even more necessary.

The furnaces are fitted with Peabody-Fisher wide range mechanical atomizing oil burners, 2 to each boiler, arranged vertically. Each burner is capable of supplying sufficient No. 6 Bunker "C" fuel oil to generate approximately 35,000 lb. of steam per hr. Since each boiler has a capacity of 57,000 lb. of steam per hr. the removal of a burner causes only a momentary drop in header pressure. Ordinary operating procedure is to run one turbine with one boiler, but if conditions warrant two turbines can be run from one boiler. Hence, it is only under the latter condition and at high loads that appreciable steam pressure fluctuations occur when a burner is removed for cleaning. This would be for only a short period of time since clean burners are always available and ready for use.

Fuel oil is heated by 50-lb. pressure steam in high-pressure vertical Griscom-Russell straight tube heaters. Two heaters are provided, one for normal operation and the other, a spare. The 50-lb. steam pressure (298 deg. F.) was adopted to pre-

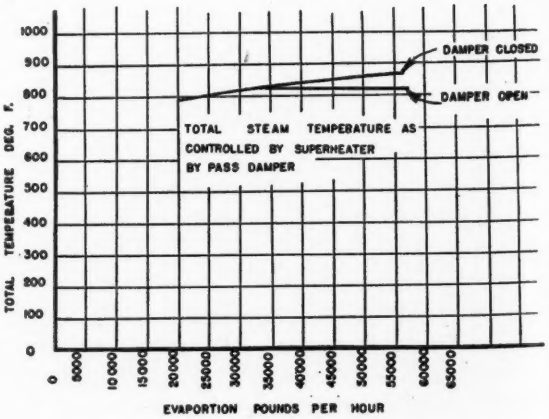

Fig. 14. Curves showing the effect of the superheat damper control

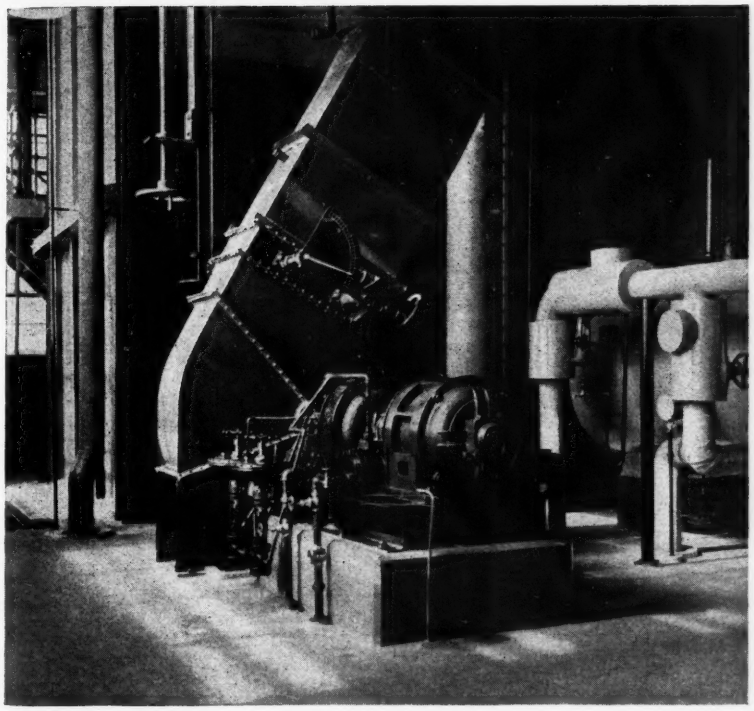

Fig. 15. Forced draft fan No. 1

Fig. 16. Interesting and graceful concrete stairway construction

vent cracking of the fuel oil with the consequent carbonization in the heaters.

Both the forced and induced draft fans are driven by induction motors through hydraulic variable speed couplings. These couplings permit a range of speeds to permit the boilers to operate anywhere between 12,000 and 57,000 lb. of steam per hr. Below 12,000 lb. per hr. natural draft is used.

The nature of cement mill operation is such that a fairly steady demand exists during certain periods, although violent load swings occur during 16 hr. daily. These large and rapid swings are due to the operation of a 12 cu. yd. quarry dragline which is in service 6 days per week.

The control for fan speed, furnace draft, boiler uptake draft, fuel oil feed and steam header pressure, as well as superheat, is effected by means of a Bailey Combustion Control system. This system is designed to maintain a constant steam header pressure but corrected for CO_2. The correction is made in terms of the air supplied to the furnace in relation to fuel oil feed. A master control is provided on each boiler so that the system can be operated on a unit basis, but an interconnection is also provided so one master can operate both boilers if necessary.

Sodium sulphite, caustic soda and phosphate are used to maintain the proper sulphate-carbonate ratio of the boiler water. Although the evaporating system supplies

List of Principal Equipment Installed in The Power Plant of The National Portland Cement Co. at Guaximdiba, Brazil.

Boilers. 2—two-drum, bent tube type, 3 pass, integral furnace design, steam generators. Oil fired. Boiler H.S. 4736 sq.ft., water wall H.S., 632 sq.ft., water screen H.S., 186 sq.ft., Total H.S. boiler and furnace 5554 sq.ft. Designed on output of 57,000 lb. of steam per hr. at 650 lb. gage and 825 deg. F. t.t. Superheat 347 deg. F. at 57,000 lb.

BOILERS. Combustion Engineering Co.

SUPERHEATERS. "Elesco"—The Superheater Co.

Fuel Oil Burners. 4—two per boiler, wide range, Peabody-Fisher mechanical atomizing Toronto type, each capable of supplying fuel oil for a load of 35,000 lb. steam per hr. Peabody Engineering Co.

Fuel Oil Pumps. 2—10 g.p.m., 250 lb. pressure. Quimby Pump Co.

Fuel Oil Heaters. 2—vertical type straight tube heaters, 10 g.p.m. capable of heating oil from 100 deg. to 250 deg. F. Griscom-Russell Co.

Forced Draft Fans. 2—16,000 c.f.m. at 100 deg. F. single inlet, single discharge 8.9 in. static pressure, 1750 r.p.m. fitted with hydraulic coupling variable speed drive. Fans and couplings, American Blower Corp.

Induced Draft Fans. 2—29,000 c.f.m. at 350 deg. F., 5.7 in. suction draft. 1150 r.p.m., fitted with hydraulic coupling variable speed drive.

FANS. Prat-Daniel Corp.

COUPLINGS. American Blower Corp.

Stack. 1 Thermix steel stack. 50 ft. above center of induced draft fan rotor. Diameter of stack at top, 6 ft. 6 in. Prat-Daniel Corp.

Combustion Control System. Bailey Meter Co.

Deaerating Heaters. 2—41,000 lb. per hr. Cochrane Corp.

Evaporators. 2—1800 lb. per hr. net 80 sq.ft. Griscom-Russell Co.

Boiler Feed Pumps. 2 per boiler. 8 stage, 120 g.p.m., 3600 r.p.m. centrifugal. Ingersoll-Rand Co.

Boiler Water Level Controllers. 2½ in. Type E. Stets Co.

Turbine-Generators. 2—3750 kv-a. units. Generators, 2400-v., 3-phase, 60 cycle. Turbines, 650 lb., 825 deg. extraction condensing, bleed points 2nd, 6th, 9th and 13th stages. Designed to bleed a maximum of 11,865 lb. of steam per hr. at 3750 kv-a. Flow to turbine 42,650 lb. per hr. at 650 lb., 825 deg. General Electric Co.

Condensers. 2—horizontal, single pass, surface type, 60 in. diam. with total surface of 3530 sq.ft. 963—⅞ in. diam. tubes. Flow to condenser 30,785 lb. steam per hr. at 28 in. Hg. vacuum and 7 per cent moisture content. Allis-Chalmers Mfg. Co.

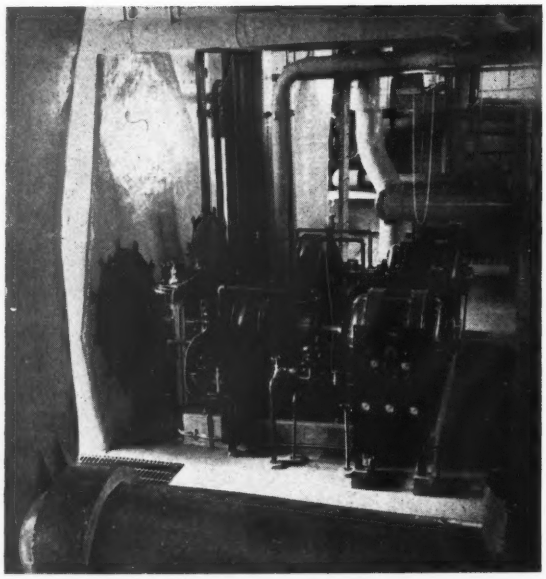

Fig. 17. Induced draft fans showing hydraulic couplings

pure water to the boiler, small amounts of brackish water tend to creep into the system. Two chemical tanks are installed, one containing sodium sulphite and caustic soda solution and the other the phosphate solution. The sodium sulphite acts as the flushing agent for any phosphate which might precipitate out in the pipe-lines. The chemicals are fed in accordance with the results of periodic chemical analysis of the boiler water. The use of this system of chemical control maintains proper pH values, prevents embrittlement, eliminates oxygen and maintains the tube surface scale free.

Each boiler is served by an 8 stage, 120 g.p.m. Ingersoll-Rand 3600 r.p.m. induction motor driven boiler feed pump, with a spare provided for each boiler. These feed pumps take suction from the deaerating heater. The discharge passes through two high-pressure heaters and their drain coolers and then to the boilers. The water level in the upper boiler drum is maintained by a Stets 2½-in. type E liquid level regulator. To maintain uniform flow through the Stets regulator regardless of load and pressure, the system is provided with a Swartwout 2½-in. type S1 differential pressure regulator, which is set to maintain a 50-lb. differential pressure across the Stets regulator. By this method a more uniform feeding of water to the upper drum of the boiler is effected. The feed to each boiler is metered by a Builders Iron Foundry Venturi Meter. The meters measure the discharge from each pump regardless of whether one or two boilers are being operated.

Water level in the upper drums is indicated by Diamond Power Specialty Co. Bi-Color gage glasses, provided with reflecting mirrors so that the level can be noted from any point on the operating floor.

With the experience with other high-pressure plants as a guide, it was decided to use prefabricated welded pipe for all lines above 1½-in. diam. All high-pressure and temperature lines are stress relieved after being welded in the shop. Low-pressure lines also were prefabricated but not stress relieved.

Because of the difficulty of obtaining skilled labor in Brazil, care was exercised that no field welding was necessary in the high-pressure piping. At points where joints were necessary, flanged connections were used. All prefabricated piping was shipped from the United States ready for field assembly. Spring supports are used to support all the high-pressure lines.

All ductwork connecting different pieces of equipment was designed with welded joints, bolted connections occurring only at the points where it is connected to the apparatus. Expansion joints of the bellows design are used throughout. Ductwork is spring supported to permit flexibility of movement.

Conclusion

It is evident that this plant, though intended only for industrial service, is more carefully and completely designed than many central stations in the United States of much larger capacity. As indicated, probably the principal reason for this high degree of refinement was the high cost of fuel and the high temperature condenser circulating water. Reliability, however, was equally important.

The station is abundantly equipped with instruments. Recording instruments are used on all important steam, air, fuel oil and condensate lines so that the complete heat distribution may be recorded. Accurate records provide a check on the operating conditions.

Circulating water for the main condensers is obtained from a channel leading in from Guaxindiba River. The condenser discharge is into the Gamba River which discharges downstream into the Guaximdiba. The twin intake structure was built with trash racks for preventing driftwood from entering the fine screen back of the trash racks.

Circulating water is forced through the condensers by two vertical centrifugal pumps driven by constant speed induction motors, each pump having a capacity of 9970 g.p.m. The circulating water flows through a 42-in. concrete pipe laid underground to a point just outside the power plant building; at this point it reduces to 36 in. diam. and changes to welded steel. This runs into the turbine room basement where taps are taken off to the two condensers. A short run of 36-in. steel pipe is used for the condenser discharge which empties into a sealing well. A 42-in. pipe leads from this well to an open channel connecting to the stream already referred to.

Space does not permit even a brief description of the cement mill which this plant serves, but it is one of the most modern plants of its kind in the world. It consists of two 400-ft. long kilns and one 244-ft. 6 in. long, together with crusher plant and storage facilities. Included is a well equipped machine shop and service building. The electric power system is connected with the Ebasco subsidiary in the region by 44,000-v. tie lines through a substation on the property. Raw material is obtained from a nearby quarry.

In closing we wish to extend credit to the officers and engineers of the Lone Star Cement Corp. in New York for furnishing all the material used in the preparation of this description, including the photographs and drawings.

Reducing Valve Wear by Hard-Facing

Experience with alloy seating surfaces shows advantage of surfacing valves for high-pressure, high-temperature service

By R. L. Lerch, *Haynes Stellite Co., Kokomo, Ind.*

WITHIN the last few years, many steam power plants have taken advantage of the higher efficiencies possible with higher temperatures and higher steam pressures. In 1930, the top steam pressure in common use was around 600 psi. and few plants carried steam temperatures beyond 750 deg. F. Today 1500 psi. units and steam temperatures of over 900 deg. F. are numerous, with several units operating at even higher pressures and temperatures.

Parallel developments in alloy materials, both steel and non-ferrous, have been largely responsible for increasing the capacity of the new high-temperature, high-pressure units. One of these alloys, a cobalt-chromium-tungsten hard-facing material, is used for valve seating surfaces trim. It has been proved in numerous plants that this alloy has provided extended, maintenance-free service life for the valves on which it has been used, and has thus contributed to efficient, continuous operation.

The accompanying table lists a few plants and valves picked at random to indicate the type of service for which this alloy hard-facing material is used. It is particularly significant that these valves are used under steam conditions as high as 1350 psi. at 925 deg. F., as in the new Philadelphia Electric Co. Station at Chester, Pa., and for feedwater lines at 3200 psi. and 495 deg. F., as at the new Twin Branch installation.

While few long records are obtainable on the performance of valves under such extreme conditions, because such plants have been operating under these conditions for less than 2 yr., the experience of the Hawaiian Electric Co. in using hard-faced valves in its Honolulu and Waiau plants is typical. In the Honolulu plant, the main steam line carries steam at 650 psi. pressure at a temperature of 850 deg. F. The valve controlling this 12-in. line is shown in Fig. 1. This valve was installed over 8 yr. ago. It is still performing satisfactorily and, more important, it has not yet been necessary to refinish the seating surfaces—after more than 45,000 hr. of service.

At Waiau, a 10-in. steam line uses both stop and non-return valves for service on steam at 650 psi. and at a temperature of 850 deg. F. The valves controlling this line were hard-faced and placed in operation in 1938 and have been in continuous service ever since.

The boiler feed valves at the same plant operate at 900 psi. and at 350 deg. F. They have also been in continuous service since the plant began operation. The valves have had over 24,000 hr. of use without repair.

Other Hard-Faced Valve Installations

In the Mountain Creek Station of Dallas Power & Light Co. in Dallas, Texas, the power-control and non-return stop valves shown in Fig. 2 stand up under the severe operating conditions of steam at

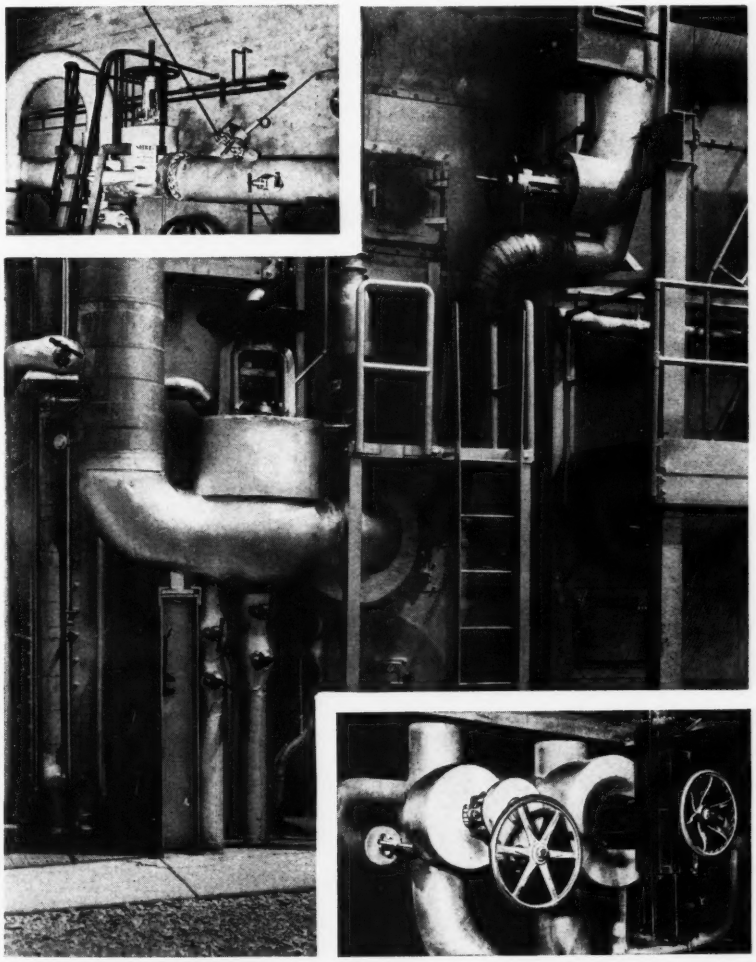

Fig. 1. (Upper Left) Hard-faced main steam stop valve in Honolulu power plant of Hawaiian Electric Co., Honolulu, T. H.

Fig. 2. (Center) Power-control and non-return stop valves in the Mountain Creek Station of Dallas Power & Light Co., Dallas, Tex.

Fig. 3. (Lower Right) Feedwater regulating valve and by-pass valve at the Chester Station of the Philadelphia Electric Co., Chester, Pa.

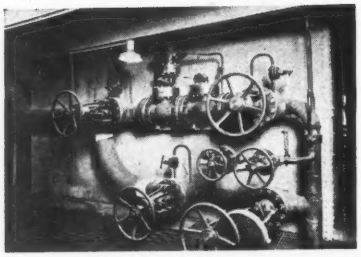

Fig. 4. High-pressure boiler valves at the Delray Station of the Detroit Edison Co., Detroit, Mich.

840 deg. F. and 710 psi. pressure. The regulating and stop valves on the boiler feedwater line at this station operate at 390 deg. F. and 1100 psi.

At the new addition to the Chester Station of the Philadelphia Electric Co., the hard-faced 6-in. feedwater regulating valve and the 4-in. by-pass valve handle steam at 400 deg. F. and 1650 psi. pressure. These two valves are shown in Fig. 3. A 6-in. angle stop valve controls a boiler feed connection at Chester Station at 410 deg. F. and 1700 psi.

All of the valves shown in Fig. 4 on the three high-pressure boilers at the Delray Station of the Detroit Edison Co. have hard-faced seating surfaces. At this station all the valves in the valve nest for the five low-pressure boilers are also hard-faced.

The comparatively new municipal power plant at Lansing, Mich., operates a 6-in. hard-faced globe valve to throttle steam, at 900 deg. F., from 950 psi. pressure down to 250 psi. pressure. The feedwater lines, at 1110 psi. pressure and 400 deg. F., are equipped with 6-in. hard-faced wedge gate valves.

In the Ripley Steam Electric Station of Kansas Gas & Electric Co. at Wichita, Kan., the 10-in. motor-operated gate valve shown in Fig. 5 is on the main turbine header handling steam at 825 deg. F. and 650 psi. pressure. A 3-in. gate valve is also used as a throttle valve to a turbine-driven boiler feed pump, controlling steam at a temperature of 825 deg. F. and a pressure of 650 psi.

The blowdown valve, shown in Fig. 6, has operated at the Mahoningside Station of the Ohio Public Service Co. at a pressure of 830 psi. and a temperature of 525 deg. F. for over 3 yr., and still operates efficiently after this long period of trouble-free service.

Selection of Seating Materials

In valve construction the selection of hard-facing materials for seating surfaces is of vital importance. For a material to be satisfactory it must possess high resistance to abrasion, corrosion, erosion, and the combination of all three. It must also withstand high pressures and temperatures without scoring or seizing.

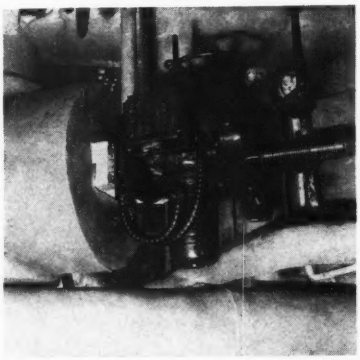

Fig. 5. Gate valve on the main turbine header at the Ripley Station of Kansas Gas & Electric Co., Wichita, Kan.

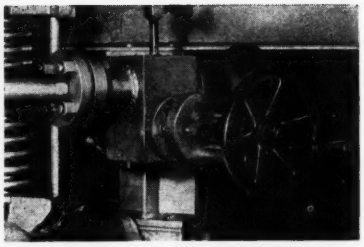

Fig. 6. Blowdown valve at the Mahoningside Station of Ohio Public Service Co., Warren, Ohio

One of the outstanding characteristics of an alloy of cobalt, chromium, and tungsten is a high degree of red hardness, which means it will be hard and abrasion resistant even in the red-heat range. Figure 7 shows that at 750 deg. F. this alloy is practically as hard as at room temperature. Even at temperatures above 1250 deg. F. it is still hard and abrasion-resistant, and it has the added advantage of being unaffected by heat-treatment, recovering its original hardness after being heated to any temperature up to 1850 deg. F.

This alloy takes a high polish,

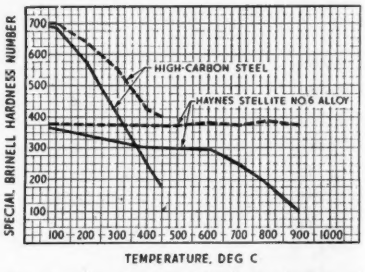

Fig. 7. The Special Brinell hardnesses of Haynes Stellite No. 6 alloy and high carbon steel at temperatures from 60 to 1650 deg. F. are indicated by solid lines; their hardnesses after cooling from these temperatures (recovery hardness)—are indicated as dotted lines

Typical high-temperature, high-pressure valve installations

Power Station	Valve Size and Type	Line Location	Service Conditions: Pressure, psi	Service Conditions: Temperature, deg. F.
Chester, Penn.	10 in., gate	Main steam	1350	925
Chester, Penn.	6 in., angle gate	High-pressure boiler feed	1800	405
Chester, Penn.	6 in., dual gate 4 in., gate	Feedwater regulating and by-pass	1650 to 1400	400
Central N. Y., Oswego, N. Y.	½, 1, 1½ in., globe	Boiler feed and vent	1500	900
Delray, Detroit, Mich.	4, 1¼, ½ in., globe	Superheated steam and drip	865	910
Delray, Detroit, Mich.	2-8 in. gate 2, 6 in., globe	Boiler feedwater	1200	400
Honolulu, T. H.	12 in., gate	Main steam stop	650	850
Mahoningside, Warren, Ohio	1 ⅛ in.	Boiler blowdown	830	525
Mountain Creek, Dallas, Tex.	8, 10 in., gate	Main steam	650	840
Mountain Creek, Dallas, Tex.	6 in., gate	Boiler feedwater	1110	390
Ottawa St., Lansing, Mich.	10 in., angle 6 in., gate	Main steam Boiler feedwater	850	900
Ottawa St., Lansing, Mich.	6 in., gate	Feedwater control	1110	400
Ripley, Wichita, Kan.	10 in., gate	Main turbine header	650	825
Ripley, Wichita, Kan.	3 in., gate	Turbine pump throttle	650	825
Twin Branch, Mishawaka, Ind.	6 in., tilting disk	Boiler feed	3200	495
Waiau, T. H.	10 in., gate	Main steamstop and non-return	650	850
Waterside, New York, N. Y.	10 in., gate 2 in. globe	Main steam Superheater drain	1300	900

has a low co-efficient of friction, and, because of its red hardness, does not easily pick up other metals on contact. These properties, with its abrasion resistance, provide resistance to scoring and seizing, while the strength and hardness at high temperatures account for its resistance to erosion or wire-drawing.

The hard-faced seating surface of a valve will not corrode or pit because the alloy is highly resistant to all forms of corrosion that might be encountered in steam service. In addition the alloy, being non-ferrous resists high-temperature oxidation or scaling.

Nowadays, when so much power is needed from the nation's power plants, it is more important than ever before that power-transmission systems operate with the highest possible efficiency. Because hard-faced valves have proved their value in steam systems, their use should be recommended whenever installation of new valves, or repair and replacement of old valves, becomes necessary.

Dew Point of Flue Gases Containing Sulfur

Part III

By JESSE S. YEAW and LOUIS SHNIDMAN
Rochester Gas & Electric Corp.
Rochester, N. Y.

ESTIMATION of the probable effect of increasing sulfur content upon the dew points of the flue products of various fuels with increasing amounts of excess air are shown by the curves on Figs. 6 and 7.

For example, a manufactured gas with a calorific value of 550 B.t.u. per cu. ft. and containing 15 grains of sulfur per 100 cu. ft. is being burned with 40 per cent excess air. The proper curve on Fig. 6 is chosen as shown by

$$\frac{\text{Grs. S/100 cu. ft.}}{\text{B.t.u./cu. ft.}} \times 100,$$

$$\text{or } \frac{15}{550} \times 100 = 2.7.$$

This represents an imaginary curve lying between that shown for 0 and that for 3, and it is close to the 3 curve. This imaginary curve represents the true dew point of all of the flue gas mixtures containing any amount of excess air. For a mixture with 40 per cent excess air, the true dew point is about 160 deg. F.

A coal containing 1½ per cent S is being burned with 50 per cent excess air. The proper curve on Fig. 7 is located between that shown for 1 per cent S and 2 per cent S. This curve represents the true dew points of all of the flue gas mixtures containing any amount of excess air. For a mixture with 50 per cent excess air, the true dew point is about 155 deg. F.

In Table V (presented in Part II) the corrosion at various locations in the flue connections at several steam generating plants has been noted. If it be considered that evidence of corrosion is also evidence of true dew point conditions, then the temperatures at these locations should also indicate the dew points of the flue gases. A summary of these data are included on Table VIII together with an estimation of the true dew points from the amount of SO_3 which was found in these flue gases. These data show that the method for the estimation of the true dew point by means of Fig. 3 (Part I) seems to check fairly closely with the temperatures at which corrosion of the flues was found. The estimated dew points are generally on the low side, but this may be taken to prove that corrosion begins even when only temporary dew point temperatures are attained in the flue connections.

That the fluctuation in such flue temperatures is not only possible but also probable is shown by the data in Table IX taken by McChesney[8] during a series of tests at a steam generating plant. These data show that, under ordinary operating conditions, flue gas temperatures of about 300 deg. F. at the outlet of the economizer varied normally by 50 to 60 deg. F.; and that, under adverse weather conditions, flue metal temperatures beyond the economizer were from 100 to 200 deg. F. below the temperature of the flue gas inside.

In conclusion it should be stated that very few actual dew point determinations have been reported for flue gas mixtures. The few which are known appear to be much too low as compared with the data estimated from the SO_3 content of the vapor or assumed from evidences of actual corrosion of the flue connections. The reason for this may be that the gases which are sampled are in a highly unstable state of equilibrium.

Small variations in the combustion conditions could result in large changes in the potential SO_3 which might be formed. This is strikingly illustrated by Curve B on Fig. 4 (Part II). Gas velocities are usually relatively high. Catalytic dusts and salts may be factors. The actual point of sampling may influence the results. The excess air as calculated from the usual CO_2 recorder may not represent conditions in the flues. Infiltration of air would lower temperatures besides adding enough excess oxygen to further accelerate the formation of SO_3. And McChesney's[8] data seems to show that perhaps more attention should be

EDITOR'S NOTE: Footnote figures refer to a list of references which may be found at the end of this article.

In the first and second parts of this article on the dew points of flue gases containing sulfur, which appeared in the January and February issues respectively, the authors showed that the presence of even a very small amount of sulfur trioxide in the gas had a definite effect upon the dew point of the gas. Since the determination of the sulfur trioxide content of flue gas is a difficult operation involving special equipment and considerable technical skill, the authors developed a method whereby the sulfur trioxide content could be estimated with a fair degree of accuracy. This method was described in Part II. Now, in this last installment Messrs. Yeaw and Shnidman sum up their thesis and show how the true dew point of industrial fuels can be estimated. They also discuss the relationship between corrosion and true dew point and the concentration of sulfuric acid at the dew point. The latter naturally is important.

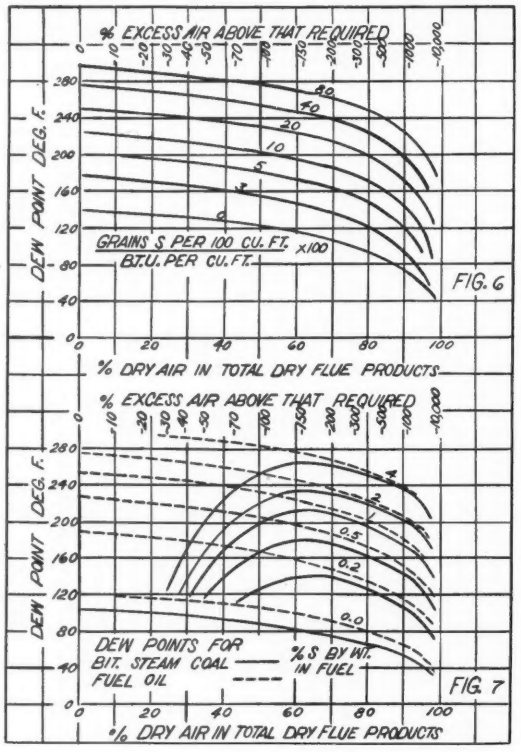
% EXCESS AIR ABOVE THAT REQUIRED
DEW POINT DEG. F.
GRAINS S PER 100 CU. FT. X100
B.T.U. PER CU. FT.
FIG. 6
% DRY AIR IN TOTAL DRY FLUE PRODUCTS
% EXCESS AIR ABOVE THAT REQUIRED
DEW POINT DEG. F.
DEW POINTS FOR
BIT. STEAM COAL —— % S BY WT.
FUEL OIL ---- IN FUEL
FIG. 7
% DRY AIR IN TOTAL DRY FLUE PRODUCTS

Fig 6. (Above) Curves showing dew points for gases. Fig. 7. (Below) Curves showing dew points for bituminous coal and fuel oil

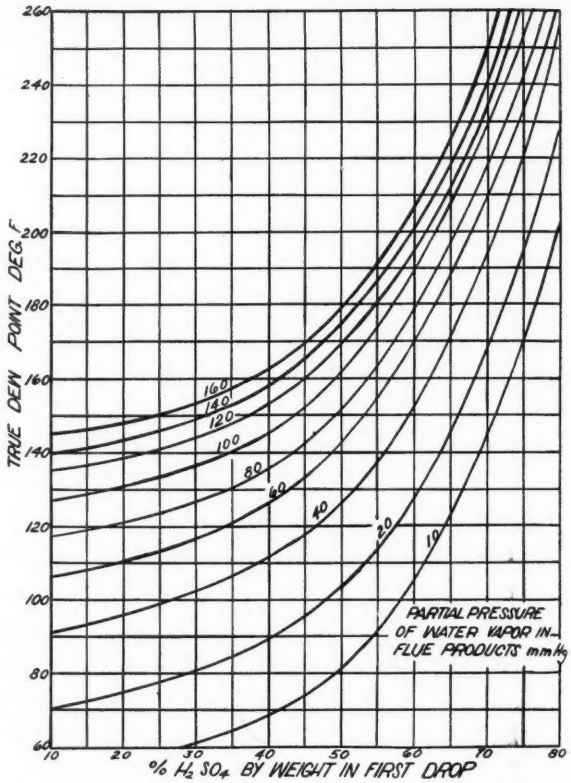

Fig. 8. Concentrations of H_2SO_4 in the first drop at the dew point of flue gases

given to adverse conditions and minimum temperatures in the matter of corrosion of flue connections.

Concentration of H_2SO_4 in the First Drop at the Dew Point

It has been indicated in certain parts of this paper that a sudden and often serious corrosion usually occurs in the flue connections, the temperatures of which have been allowed to fall to within the dew point range. Analysis of the corrosion products has shown that the corrosive medium was sulfuric acid. It is not believed that the potential strength of this acid deposited at the dew point is generally realized.

The concentration of H_2SO_4 in the first drop condensed at the dew point may be estimated from the available experimental vapor pressure data for this acid. The essential parts of the curves are shown on Fig. 8, in which the true dew point due to the presence of SO_3 in the flue gas is plotted against the per cent of H_2SO_4 by weight in the first drop condensed, and at various partial pressures of $H_2O + H_2SO_4$ (H_2O) in the vapor volume.

In a closed system, the cooling of such a vapor would result in the condensation of progressively weaker acid solutions, and the final

Table VIII. Summary of the True Dew Points for Certain Flue Gases

Plant	Fuel	% Sulfur in Fuel	% Excess Air	% SO_3 by vol. in Flue Gas Detd.	P mm. H_2O	Dew Points: Theoretical Fig. 1	Dew Points: Est. from Chart Fig. 3	Dew Points: Est. from Evidence of Corrosion
A	Coal	4.45	68	.0082	54	102	260	250—300
C	Coal	3.18	57	.0028	54	102	210	200—300
H	Coal	2.1	49	.0015	56	103	190	200—250
I	Gas & Oil	high	70	.0133	100	126	270	350—500
J	Pulv. Coal	4.67	36	.0032	59	104	220	200—250
X	Pulv. Coal	1.5-2.0	19	....	51	101	101	100—180

Studies at Plants A, C, H, I, and J reported by Johnstone [5], at Plant X by McChesney [8].

Table IX. Flue Gas and Flue Metal Temperatures

	Steam Generating Plant					
Test No.	Atmospheric Temp., °F. Min.–Max.	Flue Gas Temp., °F. Outlet Economizer Min.–Max.	Flue Metal Temp., °F. Bare Min.–Max.	Flue Metal Temp., °F. Protected Min.–Max.	Flue Gas Anal. % CO_2 Min.–Max.	Boiler Rating lb./Hr.×1000 Min.–Max.
1	0—39	268—335	96—187	164—248	13.5—16.5	70—185
2	5—42	272—350	106—172	176—253	13.5—16.0	75—215
3	6—56	280—370	124—204	198—280	14.0—16.5	110—210
4	13—45	278—360	80—185	170—254	14.0—15.7	75—210
5	14—48	270—348	120—186	172—253	13.0—16.5	70—180
6	20—44	280—340	112—187	179—244	13.2—16.2	75—190
7	18—50	272—354	120—207	188—272	11.9—17.0	70—246
8	26—53	260—358	114—196	188—262	13.8—16.3	75—200
9	24—56	275—345	125—180	192—254	13.2—16.5	80—190
Average	31	312	150	219	14.9	140

Each test consisted of 24 hourly readings at each point.
Fuel was Pittsburgh bituminous coal with 1½ to 2 per cent sulfur.
Bare flue was exposed over roof of building. Penetration occurred in about 1 yr.
Protected flue was the same, covered by sheets of galvanized iron with 2-in. air space. No corrosion in almost 4 yr. of use.

Table X. Concentration of H_2SO_4 in the Liquid Phase in First Drop Condensed at the Dew Point

Gaseous Fuels

Grs. S/100 Cu.ft. / B.t.u. per Cu. ft. × 100	% H_2SO_4 by wt. in Liquid Phase for any excess air dilution
0	0
3	50
5	60
10	65
20	70
40	75

Fuel Oils

% Sulfur by weight in Fuel	% H_2SO_4 in Liquid Phase for any excess air dilution
0.0	0
0.2	60
0.5	70
1.0	75
2.0	80
4.0	85

Solid Fuels

% Sulfur by weight in Fuel	% H_2SO_4 in Liquid Phase % Excess Air			
	0	50	100	200 or more
0.0	0	0	0	0
0.2	0	0	57	60
0.5	0	45	67	70
1.0	0	57	73	75
2.0	0	65	78	80
4.0	0	71	83	85

product would not necessarily be very strong. In an open system, however, such as a flue gas conduit, the composition of the gases is maintained by the constant supply of fresh mixtures. Thus, the condensation temperature or dew point is held fairly constant, and a liquid of practically constant composition is continuously deposited on the flue surfaces. And this liquid may be a fairly strong sulfuric acid solution as shown by the data on Table X.

It is of interest to note that only a trace of sulfur in the fuel results in the deposition of a rather concentrated sulfuric acid solution at the dew point. It is also of interest to note that the strength of the sulfuric acid deposited depends only upon the original sulfur content of the fuel in the case of the gases and fuel oils, a solution of the same strength being deposited regardless of the fraction of excess air for any single fuel.

In the case of the coals the acid deposited increases in strength with an increase in excess air up to a certain point; thereafter it too becomes constant.

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RUBBER FOUND IN COAL

RUBBER from coal! This statement does not sound right, and yet rubber has actually been found in coal. In certain German lignite mines, the workmen are familiar with rubbery fibers called "monkey hairs." These are known to consist of fossil vulcanized rubber and are the remains of rubber originally in the twigs of a type of rubber-bearing shrub now found only in Africa. The surrounding lignite contains a small proportion of sulphur, and in the course of thousands of years, the sulphur migrated and caused the formation of prehistoric vulcanizates.

This interesting note on the occurrence of rubber in coal prefaces a paper by Harry L. Fisher of the U. S. Industrial Chemicals, Inc., Stamford, Conn., in the November 1942 issue of Industrial and Engineering Chemistry. Mr. Fisher points out that the starting materials for making synthetic rubbers are the compounds known as butadiene, isoprene, isobutylene, and styrene which are present in coal gas or in coal tar although in uneconomic quantities for recovery. Other abundant products from coal that can be used in various ways for the preparation of the starting materials include benzene, phenol, ethylene, and calcium carbide.

C. A. Haag, a veteran instructor in the Purdue University machine shop, Lafayette, Ind., inspects the work of William E. Rose, a sophomore electrical engineering student from Rensselaer, Ind. Rose is one of 275 Purdue students who are producing war materials in the machine shop, once used only for routine practice work. The shop has been converted into a war production factory under the terms of a subcontract placed with the University by the Westinghouse Elec. & Mfg. Co.

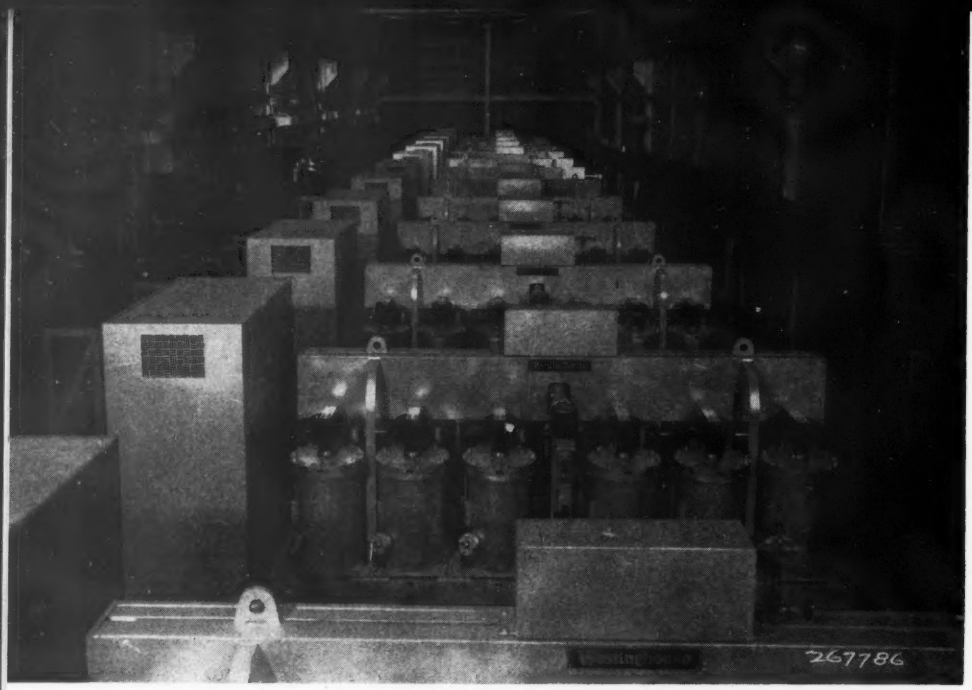

Fig. 1. Power for aluminum production is supplied by this line of Ignitrons whose total rating is 60,000 amp. at 645 v. d.c.

THE IGNITRON

For Direct Current Power

By W. E. SCHWARZ

Generator Engineering Dept., Westinghouse Elec. & Mfg. Co.

THE NECESSITY and advantages of direct current for certain processes has resulted in its use in a number of varied industries. For economic reasons, practically all power is generated as alternating current at a comparatively few sites near abundant sources of fuel or water power and transmitted at high voltage to the points of application. Wherever direct current is desired, the conversion is usually accomplished by means of motor-generator sets, synchronous converters, or mercury arc rectifiers.

Through the continuous maintenance problems of the first two types of apparatus, the conversion by rotating equipment has become very familiar to all power plant operators. Today, however, more and more users of direct current power are going over to the Ignitron mercury arc rectifier because of its many advantages over all other methods of conversion.

A very brief review of the electronic theory will serve as a background towards the understanding of the principle of the Ignitron.

According to one theory, all matter can be broken down to small electrically neutral particles called atoms, consisting of a positively charged nucleus around which revolve one or more negatively charged particles called electrons. The electrons are held in place by a force of attraction between them and the positively charged nucleus. It is possible to dislodge electrons from neutral atoms at a high temperature or under the influence of an electric field. In a gas this separation is caused by collision of oppositely charged particles and produces an ionized gas consisting of electrons, positive ions, and neutral atoms.

In an ionized gas, the movement of the electrons and positive ions towards the positive and negative electrodes respectively constitutes a flow of current. Each electron possesses an electric charge of 1.59×10^{-19} coulomb. Therefore, 629×10^{-16} electrons, or equivalent positive ions are required per second for each ampere of current.

Since the mass of a positive mercury ion is 370,000 times that of an electron, practically all the current is conducted by electrons. These electrons are supplied by the mercury cathode through the medium of a cathode spot, an incandescent spot on the surface of the mercury at which electrons are emitted at very high velocity.

With a cathode spot on the negative electrode, in a low-pressure gas, the positive electrode or anode will pick up current when a positive potential is applied. If the voltage becomes zero or negative, the movement of electrons towards the anode stops and the flow of current ceases, thus per-

mitting current to flow in one direction only. The alternating impulses taken from the a.c. supply are therefore modified by the rectifier in such a manner that current from the negative portion of the wave is suppressed.

As the number of secondary phases of the rectifier transformer is increased, the voltage output becomes smoother, but the time each phase is active is reduced. Obviously, use of more phases decreases the utilization of the anodes and the windings.

The 3-phase connection is a desirable compromise between utilization of the phases and waver form. By special connections of transformers, a large number of anodes may be made to operate in groups of three, giving the utilization of three phases and the wave form of a greater number of phases.

Since a cathode spot cannot be created reliably in a low-pressure gas by the application of high voltage, it is necessary to start a rectifier by some other means. The Ignitron principle provides a method of starting an arc reliably in a few microseconds. This method is based on the fact that when current is passed between high and low resistance material in contact, a sufficient gradient is set up at the junction of the two materials to create a cathode spot. This method is amenable to synchronous application.

The arc is started in each Ignitron tube each cycle by passing current through the ignitor at the start of the conducting period. At this instant, the main anode, being positive with respect to the cathode, picks up the arc and carries the current demand by the load.

Ignitron Circuit

The Ignitron circuit is designed to give a pulse of current once each cycle through the ignitor rod to the cathode. The charging transformer is phased out with respect to the rectifier transformer so that the excitation impulses have the correct phase relationship with respect to the voltage applied to the Ignitron anodes.

As the voltage from the charging transformer becomes positive on its sine wave, current passes through the linear reactor and charges the condenser. This condenser voltage is continuously applied to a saturating reactor. When the voltage reaches a value at which the reactor saturates, the capacitor is discharged through the reactor, and a large peak of current in this circuit results. By the use of Rectox units, it is possible for one circuit to supply excitation power to two Ignitrons which are displaced 180 deg.

The flow of current from ignitor to cathode creates the cathode spot. Figure 4 shows the control cubicle for a 3000-kw. Ignitron rectifier.

Construction of Ignitron Rectifier

Ignitron rectifiers are usually assembled in groups of six or twelve individual Ignitron tubes connected to a common vacuum pumping system, with all auxiliaries necessary for maintaining

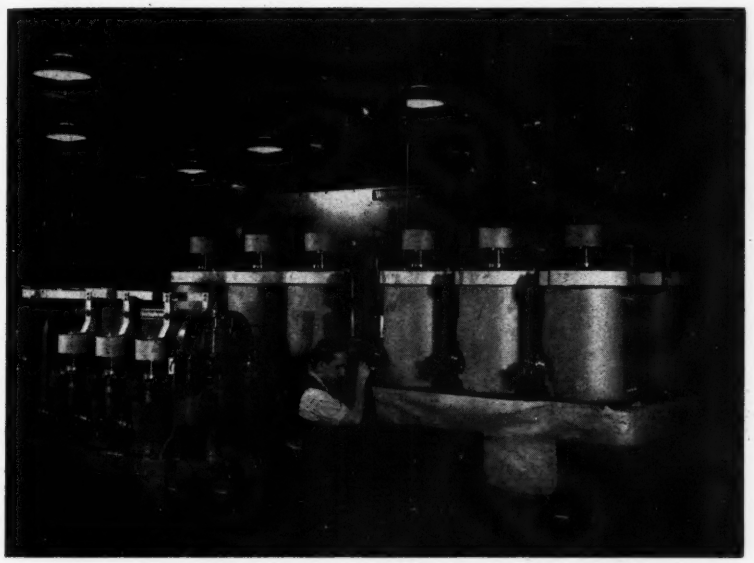

Fig. 2. (Left) 300-kw. and 3000-kw. Ignitron rectifiers for industrial applications being checked before shipment. Correct ignitor immersion is essential for proper operation

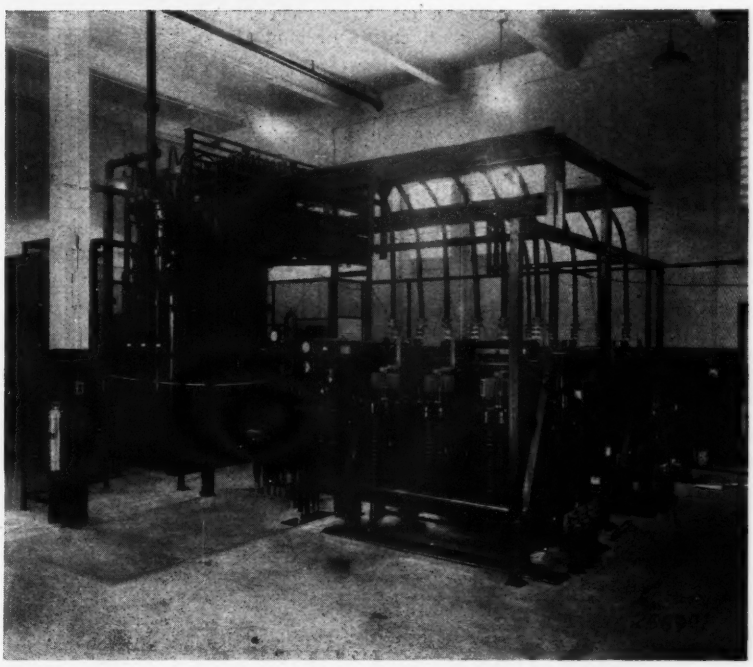

Fig. 3 (Below) 3000-kw., 640-v. railway substation consisting of two 6-tube sections. Of utmost importance, Ignitron rectifiers operate at high efficiency particularly at light loads. They give high overload capacity and instant availability

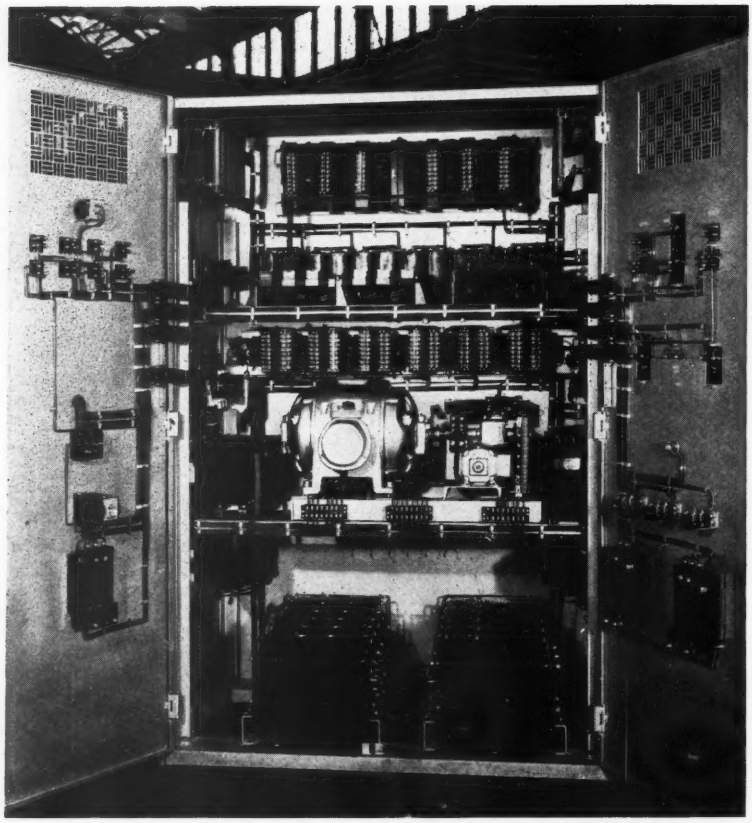

Fig. 4. Control cubicle for a 3000-kw. Ignitron rectifier showing the reactor firing circuit for a 12-tube section. Direct current voltage control in this particular circuit is accomplished by mechanical phase shifting

the correct vacuum and temperature. Figure 2 contrasts a 300-kw. with a 3000-kw. Ignitron rectifier.

The quality of performance given by a rectifier is determined by the quality of construction. Careful attention must be given in the design so that parts and surfaces are arranged to provide the necessary de-ionization and gradients with the least obstruction to the arc, and also so that the mercury vapor flows from its source at the cathode to the condensing surfaces with the least possible turbulence, thus maintaining the vapor pressure necessary for best operation.

An Ignitron tube consists of a gas-tight steel container in which there is the graphite anode and the mercury cathode. The phenomenon of rectification does not depend on the material of either the gas or the electrodes. Mercury, however, is particularly suitable for the cathode since it is liquid at ordinary temperatures, and a vapor at temperatures which are readily reached and maintained.

Mercury has the proper density and characteristics for both the required conductivity and insulation strength. Moreover, the vaporized mercury is not permanently removed from the cathode surface, but condenses and returns to the cathode so that the cathode is continuously and automatically renovated.

The anode or positive electrode is graphite which withstands the operating temperature better than most materials and does not melt but vaporizes directly, thus withstanding arc-backs with negligible injury. The ignitor is a pencil-point shaped rod of high resistivity used to initiate the cathode spot each cycle.

The shield is a perforated basket-shaped de-ionizing electrode enveloping the anode but insulated from it. Its purpose is to de-ionize the space around the anode when negative voltage is applied as soon as it ceases to carry current, thus preventing positive ion bombard-

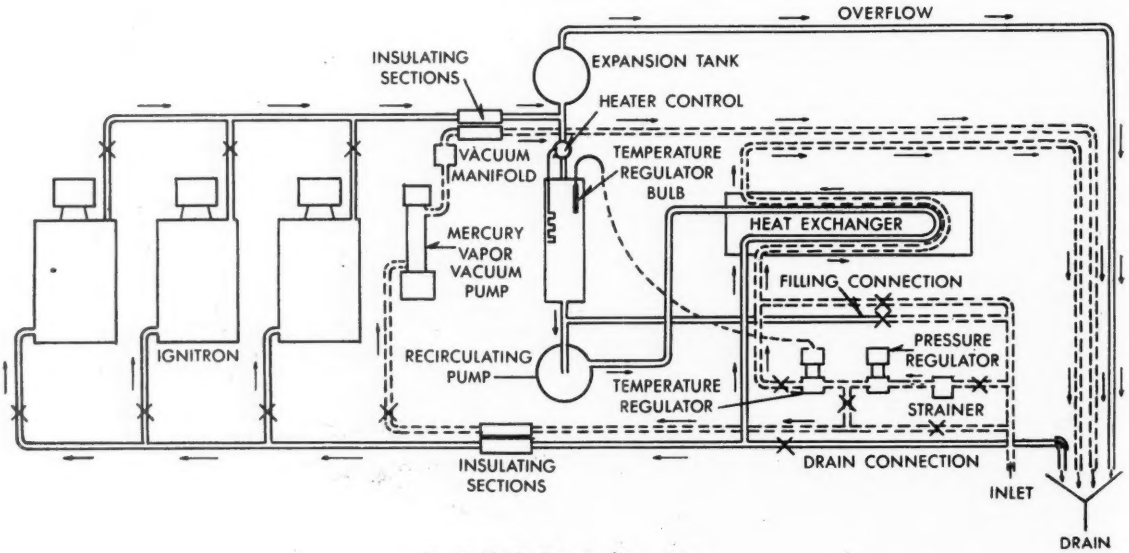

Fig. 5. The Ignitron cooling system

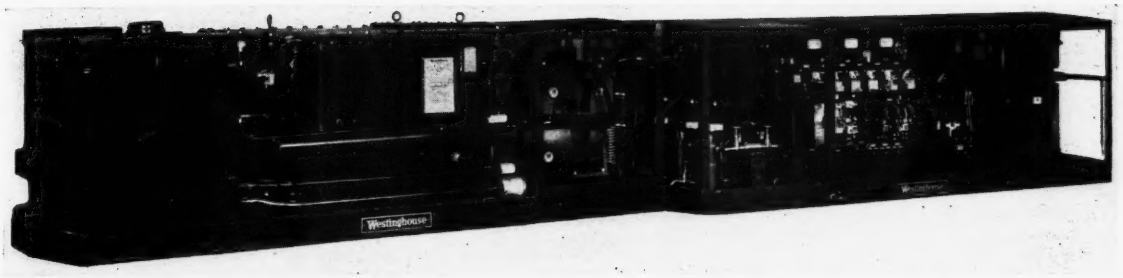

Fig. 6. 300-kw., 275-v. completely automatic portable Ignitron substation for low head coal mine service. The Ignitron rectifiers are particularly suited to the needs of mining service. They can be installed in isolated places, can be made portable if required

ment of the anode which may result in the formation of a cathode spot on the anode.

The normal flow of current is from anode to cathode. If, however, a cathode spot should develop on one of the anodes, that anode will act as a cathode, and current from the other cathodes will flow to it. This is called arc-back. Once formed, a cathode spot on the anode will maintain itself as long as current is conducted to it, and the rupturing of this current requires the opening of protective circuit breakers.

The elimination of the source of ionization in the Ignitron during the period in which the anode must withstand high reverse voltage removes a chief cause of arc-back. This makes it possible to reduce the anode-cathode spacing and the amount of shielding, thus decreasing the arc drop with a consequent gain in efficiency.

It is necessary to provide a cooling system for the rectifiers to dissipate the heat of the arc and to control the mercury vapor pressure. Copper coils are soldered to the outside of each tube and in the larger sizes several turns of copper lined steel coils are placed on the inside near the cathode. Cooling water is circulated through these coils to maintain a tube discharge water temperature of 50 to 55 deg. C. The water consumption is somewhat less than 0.4 g.p.m. per hundred amperes of rectifier load. A diagram of a typical Ignitron cooling system is shown in Fig. 5.

Advantages of Ignitron Rectifier

The outstanding advantages of the Ignitron rectifier over rotating types of converting equipment are briefly enumerated below:

1. Uniformly high efficiency over the entire load range. The efficiency is the ratio of the power output at the d.c. terminals to the power input at the high tension terminals of the transformer. The component losses of the unit are the copper and iron losses of the transformer, the loss in the rectifier arc, and the power for operation of the standard rectifier auxiliaries.

The losses of the transformer are in proportion to the kilowatts output and vary from 1 to 2 per cent depending upon the size of the unit. The arc loss of the Ignitron rectifier, however, is practically proportional to the d.c. load amperes, there being only a very few volts difference in the arc-drop between light load and full load. The power required for the rectifier auxiliaries is small. It is obvious, therefore, that the efficiency remains practically constant over the entire load range, and that the efficiency increases as the operating voltage is increased.

Ignitron Efficiency Is High

For 250 v. d.c. operation, the efficiency of the Ignitron is higher than that of a motor generator set throughout the normal load range. It is higher than the efficiency of a synchronous converter up to 50 per cent load, and lower beyond 50 per cent load.

For 600 v. d.c. operation, the Ignitron unit efficiency is higher than that of a motor generator set throughout the normal load range. It is higher than the efficiency of a synchronous converter up to 100 per cent load, and lower beyond 100 per cent load in the larger ratings.

For operation at d.c. voltages above the 600-v. d.c. class, the efficiency is higher than that of all rotating conversion units throughout the normal load range.

2. Low maintenance and operating costs. Many characteristics inherent in the principle of operation of the Ignitron rectifier provide reduced maintenance and operating costs. The most important of these is the absence of commutators, brushes, collector rings, windings, and bearings, which require periodic maintenance and replacement.

No parts of the rectifier unit require periodic replacement, since the interior parts operate in a near perfect vacuum, the cathode is automatically renovated and the cooling system is protected against corrosion. Moreover, in contrast to rotating equipment, Ignitron rectifiers require no special air cleaning or ventilating service.

The high efficiency, simplified automatic operation, freedom from problems of high starting demand, synchronization, and reverse current, all contribute to greater operating economy in Ignitron rectifier stations.

3. High short-time overload capacity. Since the only effect of an excessively high current in an Ignitron rectifier is the generation of heat with increased vaporization of mercury, a momentary overload or even a short circuit cannot damage the equipment. Provided the overloads are removed within a reasonable time, the Ignitron will readily handle applications involving high load swings.

4. Ease of installation. An Ignitron rectifier is installed simply by placing it on a reasonably level concrete floor of sufficient strength to support the dead weight alone, since there is no vibration. Installation consists simply of putting the unit in place and connecting the control leads, power leads, and water supply. No special ventilation need be provided for the rectifier since the ordinary convection in a closed room is sufficient to maintain satisfactory temperatures on any air-cooled parts.

5. Lightweight and compactness. Though sturdy in construction, the rectifier is lightweight and compact, a decided advantage where space is at a premium or portability desired.

6. Quiet operation. The Ignitron rectifier is remarkably quiet

(*Continued on page* 110)

REA Diesel Plant Meets Problems of War

Diesel plant at Hampton, Iowa, of 5250-hp. capacity, faces full-load operation without plant expansion for the duration of the war; chief problems are to keep load from growing and to cut peaks

By William H. Gottlieb

EVEN amid the farms of Iowa, the war is bringing serious new problems and is shifting the points of emphasis in power plant operation. In time of peace, the utility, municipal or REA plant, supplying civilian needs, sought constantly to augment its load and encourage ever greater consumption of electric power. It was then an obvious fundamental of good engineering and management to foresee expansion of demand and to expand generating capacity in anticipation of that demand. No public supplier would dream of permitting reserve capacity to dwindle to a point where failure of a single prime mover would make it impossible to carry the peak load.

The war has changed all that. Power plants which serve only civilian need cannot expect to obtain new prime movers. They must contrive to keep peak demand below generating capacity and to keep every power producer in efficient operating condition until the undetermined date when peace again makes plant expansion possible.

One plant that is meeting these problems with success and ingenuity is the 5250-hp. Diesel plant of the Federated Co-operative Power Association at Hampton which serves more than 9000 farm consumers in 16 Iowa counties in the north central part of the state. This REA plant energizes 4200 mi. of line for the six cooperatives that make up the association. It is a comparatively new system, just 4 yr. old, and the war found it in the midst of a vast and rapid expansion. The plant went into service on March 17, 1938, with one 750-hp., 3-cylinder, 17 by 25-in., 257 r.p.m., 2-cycle, mechanical-injection, cross-head type Nordberg Diesel, direct-connected to a 525-kw., 3-phase, 60-cycle, 2500-v. Elliott generator, with 20-kw., chain-driven exciter, and one 1000-hp. Nordberg Diesel of the same type, speed and cylinder size, direct-connected to a 700-kw. Elliott generator.

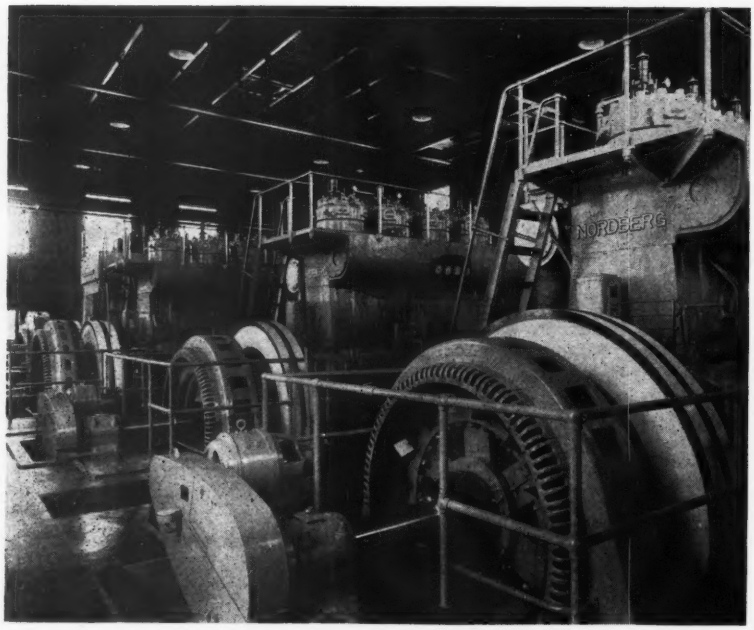

Fig. 1. The four Nordberg Diesels in the Federated Co-op power plant have a combined capacity of 5250 hp.

August, 1939, brought the installation of a 1500-hp. Nordberg Diesel, again of the same type and cylinder size, with a direct-connected 1050-kw. Elliott generator and 20-kw., chain-driven exciter. In January, 1941, plant capacity was greatly increased with the installation of a 2000-hp., 5-cylinder, 21 by 29-in., 225 r.p.m., 2-cycle, mechanical-injection, cross-head type Nordberg Diesel with a direct-connected 1410-kw. Electric Machinery generator with 25-kw. chain-driven exciter.

This was indeed rapid expansion of generating capacity, but once the possibility of further expansion was closed, the growing load threatened to outstrip capacity. In December, 1941, less than a year after installation of the last engine, peak load actually exceeded total rated plant capacity, hitting a high point of nearly 4000 kw. Kilowatt-hour production rose from 2,153,100 in 1939 to 9,950,810 in 1941 and the trend is still upward. May, 1942, the last month for which figures are available at this writing, was the top production month in the plant history with 1,129,900 kw-hr., although May is normally a low month. Average monthly production is now running

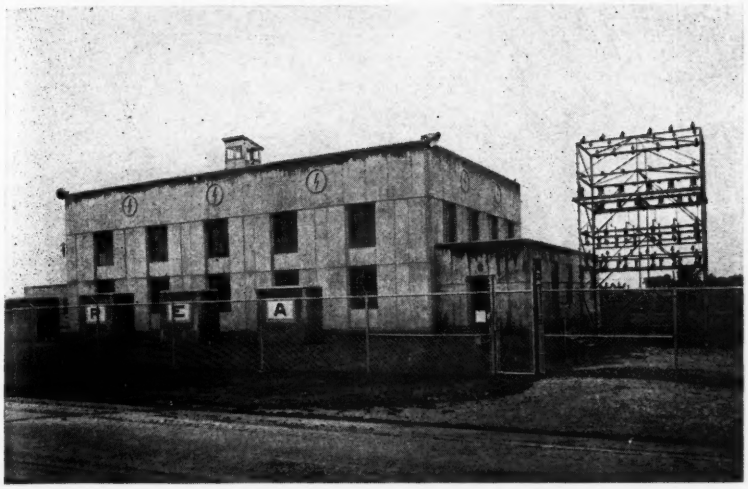

Fig. 2. Diesels housed in this concrete and steel structure serve 9000 rural customers in Iowa. The concrete pillboxes in front of the plant house American Air Filters

well above 1,000,000 kw-hr. with the peak months still ahead. If events are allowed to take their normal course, the peak load in December, 1942, will be between 10 and 20 per cent above the overload month of December, 1941, and obviously the plant cannot be called upon to carry this increase.

Arthur Oliphant, plant superintendent, expects to find the answer in voluntary rationing with the mailed fist of compulsion in the background as a last resort. A letter is going out to all consumers explaining the problem and asking each one to turn out the equivalent of two 60-watt bulbs at a signal from the plant and keep them out for 2 hr. The signal will be two dips in voltage. If all the 9100 cooperative members take this action, the peak will be cut more than 1000 kw. If the voluntary response is not forthcoming, plant management will be forced to demonstrate the seriousness of the situation by pulling the switch on part or all of the system. Mr. Oliphant is sure that he will obtain full co-operation — once consumers become aware of the necessities of the situation.

Engine Dependability Imperative

Emergency means of reducing excessive peak loads does not diminish the imperative need of keeping every prime mover in the plant ready for efficient service. The war is putting major emphasis on engine dependability, on protective accessories and on sound maintenance routine. On all three counts the Federated Co-op power plant has a notable record of success. In more than 4 yr. of operation, generating over 28,000,000 kw-hr., running at times with an overload, the plant has not had a single engine failure. Despite the increasing problems of operation, engine efficiency has been improving steadily from year to year. Starting with the satisfactory return for fuel of 11.52 kw-hr. per gal. in 1938, the plant reached the lofty level of 13.69 kw-hr. per gal. for the first 5 mo. of 1942. Lube oil consumption also has gone from very good to even better. Here is the picture of improvement for the life of the plant:

Fiscal Year	Kw-hr. Produced	Fuel Consumed	Lube Oil Consumed	Kw-hr. per Gal. of Fuel
1938-39	2,152,000	186,730	1,204.5	11.52
1939-40	4,969,500	395,181	3,694.0	12.57
1940-41	7,108,300	557,268	2,800.5	12.75
1941-42	10,903,710	815,430	3,870.0	13.37
Totals	25,133,510	1,954,609	11,569.0	12.86

More detailed figures for the year 1941 and the first 5 mo. of 1942 are given in Table I, which shows monthly kilowatt-hour production, fuel and lube consumption, kw-hr. per gal. of fuel, hp-hr. per gal. of lube, load factor and other data. It will be observed that rated hp-hr. per gal. of lube consumed has been consistently over 6000 for nearly a year, over 7000 for 9 mo. and has gone as high as 8945. The first 5 mo. of 1942 are included primarily to show the increases in load over the corresponding period of 1941. Kilowatt-hour production rose 43 per cent, peak loads an average of 36 per cent. It is evident that management is not exaggerating its war load problem.

The plant's high level of efficiency has resulted naturally in a record of production economy. For the year 1941, total operating costs, including fuel, lubricating oil, labor, maintenance, supplies, taxes, insurance, interest and depreciation, totaled $77,497.90. With 9,950,810 kw-hr. generated during the calendar year, the total cost per kilowatt-hour was only 7.68 mills. The greater activity in 1942, without any increase in fixed charges, will bring unit costs down still further. Table II gives the itemized cost figures. It is apparent that operating designed to keep engines at peak efficiency to meet war problems is good operating at any time.

The Diesels are of a heavy-duty

Fig. 3. A Honan Crane activated clay purifier is used to clean fuel

Table I. Operating results at Hampton Diesel plant

Month	Kw-hr. Produced	Fuel Consumed	Lube Oil Consumed	Kw-hr. Gal. Fuel	Hp-hr. Gal. Lube	Load Factor	Peak Load
Jan. '41 ...	733,600	56,487	312.5	12.95	5075	65.9	2400
Feb.	644,800	50,402	208	13.18	4651	66.1	2375
March	735,000	54,853	294	13.37	5162	68.8	2380
April	754,000	58,303	469	12.93	3409	69.6	2425
May	781,450	61,065	475	12.78	3567	67.3	2300
June	810,200	63,685	473	12.72	5634	64.5	2160
July	792,660	58,772	267	12.72	6276	67.1	2225
Aug.	873,000	66,453	242	13.48	7705	66.8	2300
Sept.	809,500	60,858	274	13.30	6410	65.6	2900
Oct.	938,900	69,868	292	13.43	7034	65.1	3280
Nov.	983,300	73,876	244	13.31	8532	69.7	3580
Dec. 1,074,400		79,945	275	13.44	7907	70.3	3985
Total or Av..9,950,810		754,566	3825	13.14			3985
Jan. '42 ...1,047,100		75,331	298	13.90	7195	69.9	3400
Feb. 964,800		69,742	282	13.83	6941	70.2	2600
March 1,074,400		77,532	279	13.86	7878	69.6	3100
April 1,041,300		77,529	240	13.43	8945	68.9	3000
May 1,129,900		84,261	291	13.41	8048	68.6	3000
Total or Av. 5 mo..5,257,500		384,395	1390	13.69			3400

type designed for long, continuous service. The cross-head design aids in preserving engine efficiency. These mechanical injection units are capable of burning a heavy fuel, an advantage which has not been neglected by Hampton. For 3 yr. the plant has used a 21 gravity Texas crude for which it now pays 5.853 ct. per gal. The oil is clean, but plant engineers make a policy of purifying every material that enters the Diesels. Their policy can be summarized in these words: Get an engine rugged enough to stand abuse and then do everything possible to protect it against abuse.

The fuel is delivered in 10,000-gal. tank car lots and unloaded by gravity into three 50,000-gal. storage tanks. In the course of operation, fuel is put through a pair of centrifuges and stored in a 5000-gal. supply tank from which it is pumped through meters to the individual 300-gal. day tanks in the plant basement. Engine supply pumps take fuel from the day tanks through duplex filters. For some months, Mr. Oliphant has been experimenting with an activated clay fuel purifier and results have been excellent.

Lubricating oil for bearing lubrication and piston cooling is circulated under pressure through each engine by a gear pump driven off the crankshaft. Included in each circuit is a shell-and-tube oil cooler and a bag-type filter. Each engine is equipped with a motor-driven auxiliary lube pump which is used regularly to bring up pressure before starting and to cool the engine when it is shut down.

Adequate provision is made for lube purification. Two activated clay purifiers are in continuous service, drawing oil from the engine crankcases, cleaning it and returning it to the crankcases. Each reclaimer is piped so that it can serve either of two engines; one unit is hooked to the 2000-hp. and the 1500-hp. Diesels and the other to the 1000-hp. and the 750-hp. Diesels. This has proved satisfactory since, with the exception of peak periods, it is not plant practice to run the two big engines or the two small engines together. As an added precaution, oil is put through an activated clay batch reclaimer every 300 hr.

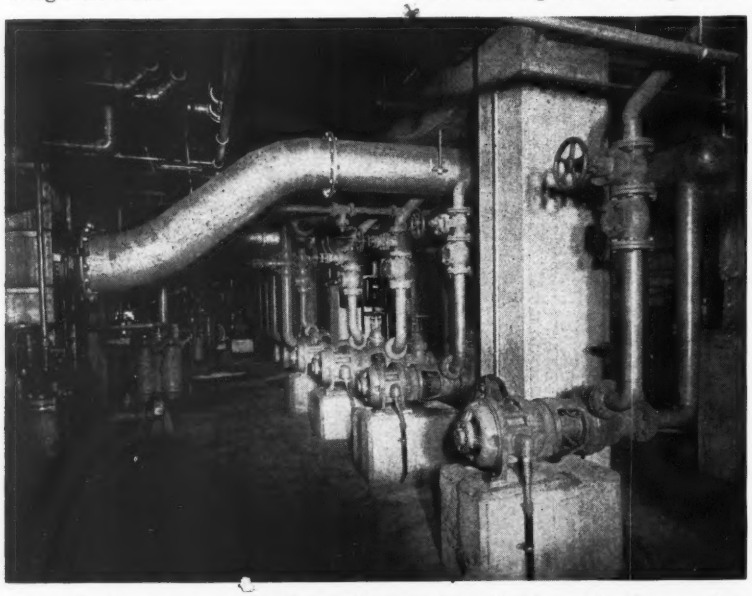

Fig. 4. Cooling water is circulated by eight motor-driven Goulds centrifugal pumps, four for soft water and four raw water

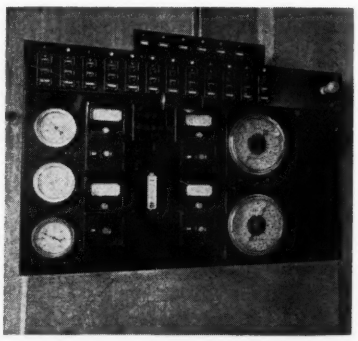

Fig. 5. Alarm panel has U. S. pressure gages, Alnor exhaust pyrometers, an Edwards annunciator, Levelometers for the fuel tanks and switches for motor driven accessory equipment

Laboratory tests every 2000 hr. show that the lube is in fine condition with no signs of deterioration. Cylinders are supplied with oil by mechanical lubricators. A new oil developed for cylinder lubrication has been in use for a year and has reduced the already-small wear on rings and liners. There have been

Table II. Operating Costs, Calendar Year 1941

Fuel	$42,385.17
Lubricating Oil	2,258.57
Labor	8,806.15
Maintenance	972.72
Supplies	1,287.74
Taxes	5,238.90
Insurance	607.54
Interest and Depreciation	16,041.11
Total	$77,497.90

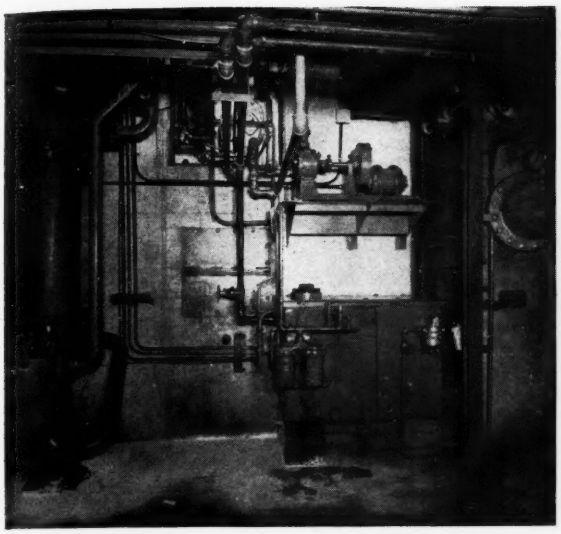

Fig. 6. (Left) This view in the plant basement shows accessory equipment for one engine including the Schutte & Koerting lube strainer and cooler at left, the Viking auxiliary lube pump upper center, the fuel day tank, duplex Nugent filter and Xacto meter lower center, and the Foster Wheeler waste heat boiler at right which utilizes engine exhaust gas to provide winter heat for the building. Fig. 7. (Right) Starting air is provided by these Witze air compressors, one of which can be driven by a gasoline engine

no stuck rings. Mr. Oliphant thinks it important to fit rings closely to the liners.

The scheme of Diesel protection demanded a closed cooling system with only soft water allowed to reach the engines. Controlled cooling is provided by a 13.5 million B.t.u. forced-draft tower which is capable of carrying the entire plant at full load. Four motor-driven centrifugal pumps draw water from a hotwell and send it through the engine jackets and the cooling tower coils and finally back to the hotwell. Make-up water is drawn from a deep well and put through a zeolite softener. Another set of four motor-driven centrifugals pump raw water over the tower. A 2400-gal. surge tank could be used to cool the engines in case of a shut down.

Four concrete pill-boxes, that harmonize with the steel and concrete design of the main plant, house batteries of impingement-type air filters for each Diesel. Exhaust gases from the two smaller engines pass through waste heat boilers to provide plant heating in winter. One of the two units is always in operation and provides an adequate supply of heat. All exhaust gases vent finally through vertical silencers at the rear of the plant.

LIST OF PRINCIPAL EQUIPMENT IN HAMPTON DIESEL PLANT

Engines—Nordberg Mfg. Co. One 750-hp., 3-cyl.; one 1000-hp., 4-cyl.; and one 1500-hp., 6-cyl., 17 by 25-in., 257 r.p.m., crosshead type, 2-cycle, mechanical-injection Diesels. One 2000-hp., 5-cyl., 21 by 29-in., 225 r.p.m., crosshead type, 2-cycle, mechanical-injection Diesel.
Generators—Elliott Co. One 525-kw., 60 per cent p.f., 3-phase, 60-cycle, 2500-v. generator; one 700 kw., 80 per cent p.f. generator; and one 1050-kw., 80 per cent p.f. generator; all with chain-driven exciters.
Electric Machinery Corp. One 1410-kw., 80 per cent p.f., 3-phase, 60-cycle, 2500-v. generator with chain-driven exciter.
Governors—Woodward Governor Co.
Fuel System—
Fuel oil—Cooper Petroleum Co.
Centrifuges—Goulds Pumps, Inc.
Meters—S. F. Bowser & Co.
Transfer pump—Geo. D. Roper Corp.
Filters—Wm. W. Nugent & Co., Inc.
Purifier—Honan Crane Corp.
Injection pumps—American Bosch.
Lubricating System—The Texas Co.
Lube oil—For crankcase. Texaco Algol.
For cylinders—Texaco Ursa X40.
Coolers—Schutte & Koerting.
Purifiers, Fuel and Lube—Honan Crane Corp.
Batch reclaimer—Renuoil. Diesel Service Co.
Cylinder lubricators—Manzel Bros.
Auxiliary pumps—Viking Pump Co.
Cooling Water System—
Cooling tower—Diesel Service Co.
Pumps—Goulds Pumps, Inc.
Softener—Permutit Co.
Air Filters—American Air Filter Co.
Exhaust Silencers—Nordberg Mfg. Co.
Burgess Battery Co.
Waste Heat Boilers—Foster Wheeler Corp.
Hoist—Whiting Corp.
Thermometers—Electric Auto-Lite Co.
Pressure Gages—U. S. Gauge Co.
Exhaust Pyrometers—Illinois Testing Laboratories, Inc.
Piston Rings—Skinner Chuck Co.
Voltage Regulators—Ward Leonard. General Electric Co.
Switchboard—Delta Star Electric Co.
Switchboard Instruments—General Electric Co.
Recording Meters—Esterline Angus.
Valves and Piping—Crane Co.

Although there are two operators on each shift to keep vigilant watch and check the pressure gages and thermometers conveniently placed on each engine, it was thought advisable to provide a complete alarm system. The alarm sounds if water pressure drops, if either soft or raw water temperatures go too high, if lube temperature rises, if exhaust temperatures go too high, or if a switchboard feeder goes out. An annunciator tells the operator where the trouble is. Each engine is provided with an automatic overspeed stop. The alarm system and an emergency lighting system are powered by a 24-unit battery set.

Mr. Oliphant has instituted a methodical maintenance program designed to keep the Diesels at maximum efficiency all the time. A complete record of all maintenance is kept with a separate sheet for each major engine part. A summary in chart form is prepared each month and an annual summary gives a complete picture of the operations and condition of each engine. The schedule calls for a weekly check of air starting valves, exciters, fuel pumps, governors and cylinder lubricators.

Twice a month a full set of indicator cards is taken. The monthly routine includes inspection of air filters, auxiliary lube pumps, cam settings, fuel filters, lube filters and fuel nozzles. Valves are checked every 3 or 4 mo. Every 2500 hr. (about twice a year) pistons are pulled for a complete cleaning and inspection.

Electrical Engineers Discuss Wartime Problems

The National Technical Meeting of the American Institute of Electrical Engineers held at the Engineering Societies Building in New York, January 25 to 29, was a strictly wartime affair. There were five full days of technical sessions, practically no social events and, of course, no inspection visits to plants. The meeting, well attended, included one session with the Institute of Radio Engineers

NOTHING it seems can stop electrical engineers from getting together—once a year at least. Despite war, travel difficulties, fuel oil shortage and meatless Tuesdays, the recent national technical meeting of the American Institute of Electrical Engineers in New York was as well, if not better attended than the winter meetings of years past. A total registration of over 1325 was recorded. This meeting, it should be noted, was not called a "winter meeting" or "convention," it was a National Technical Meeting.

In all aspects, except for the fact that a few social events were omitted, and for an unusually full technical program this meeting was essentially the regular winter convention of the A.I.E.E. There were many technical papers—too many probably—and as a rule two and sometimes three technical sessions were in progress at the same time. There were no inspection visits to plants and the only social event of any consequence was the get-together dinner on Tuesday evening, January 26, where Dr. Vannevan Bush spoke on "Research in the War Effort." Dr. Bush's address however, perhaps because of his inability to say anything about actual research developments, was not particularly interesting.

Of considerably greater interest was the joint meeting on Thursday evening, January 28, with the Institute of Radio Engineers, where Dr. George C. Southworth of Bell Telephone Laboratories, Inc., gave a lecture on ultra short wave radiation; in fact, his address was entitled, "Beyond the Ultra Shorts." A master of his subject, with a keen and well-timed sense of humor, Dr. Southworth fascinated the audience for an hour and a half with his clever exposition of the history and character of ultra short wave radiation. After listening to him explain how these waves are carried through tubes and pipes, one is forced to the conclusion that a future generation of electricians will be little more than pipe-fitters. Short waves such as those Dr. Southworth dealt with are measured in centimeters rather than meters. They perhaps are more closely related to light or heat than electricity as we usually think of it and in handling such waves we have to revise most of our concepts.

C. F. Wagner and F. J. Vogel of Westinghouse

The meeting at which Dr. Southworth spoke was concluded with a nationwide hookup over the facilities of the Columbia Broadcasting System during which the Washington banquet of the I.R.E. and the New York joint meeting was linked. Notables at each meeting addressed the joint session during this part of the program.

Of the more than 120 separate technical papers and conference papers presented during the 5 days of technical sessions only a few can be referred to here. As in previous years, the range of subjects covered by these papers covered the whole gamut of the electrical art. There were for example, highly mathematical presentations such as one by Gabriel Kron of G.E. having to do with the Riemann-Christoffel Curvature Tensor. Suffice to say, there were few of the 1325 registered at the meeting who could understand very much or even very little of the R-C Curvature Tensor. There were papers on such relatively strange subjects as the generation of electric charges by moving rubber-tired vehicles, and on long-range problems of camouflage. There were papers by women—not unusual before the A.I.E.E. where Edith Clark of G.E. has presented many fine papers, but there were new feminine faces. An excellent paper by B. R. Teare, Jr., and Josephine R. Webb, both of Carnegie Tech, discussed the skin effect of bi-metallic conductors. The studies outlined in this paper, made on copper-covered steel conductors and at frequencies up to 150 kc. indicate that for all but the lowest frequencies, its resistance is substantially that of the tubular copper portion alone and say that the resistance may be taken from simple formulas and curves already available for tubes.

Kilowatts and Kilovars

As was natural under the circumstances many of the papers presented, indeed whole sessions, were devoted to methods of extending the use of electrical equipment under wartime conditions. One of the first sessions on Monday morning, January 25, was devoted to capacitor generators and transformer loading. There was another session on the emergency loading of transmission systems later on the same day. On Wednesday, January 27, there was an entire session on "Getting the Most out of Electron Tubes in Wartime."

The first session on capacitor generators and transformer loading was devoted largely to questions involving power factor, though from the terminology employed in the papers, an "outsider" would not have known it. Reactive power, negative sequence current, kilovar generators, etc., were the terms used, to the confusion of non-electrical reporters from business publications. One nationally-known business publication asked specially for a simple diagram explaining a kilovar.

The word kilovar which denotes the "reactive" energy in an a.c. system has been coming into increased use during the past few years but it is still relatively unused among the general run of engineers. Without attempting to explain the matter in detail, a word of explanation may be of help here. An electrical system is built and operated for the purpose

(*Continued on page* 112)

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

OUT OF CHARLIE'S HEAD

Among the many anecdotes contained in the archives of the sugar industry as compiled by Dan Gutleben of Pennsylvania Sugar fame are many sound and practical suggestions for doing things easier and often better. Many of the methods employed by the old sugar tramps and the engineers they associated with are of value today. Charlie Robbins, former structural engineer of the Forrest City Iron Works, for example, is long dead but a short-cut he used is worth trying to keep in your head. Charlie, apparently, contributed many money saving ideas in steel detailing. Every construction engineer is, at times, called on by some rigger to advise if a certain beam can support the load he is about to suspend from it. Charlie had a rule of thumb for this. It is easy to remember the weight of standard beams but the section modulus requires the presence of a handbook. Charlie found that the uniformly distributed burden in thousands of pounds that a beam can support is the product of the depth by the weight divided by the span. Thus, a 15-in. by 42 lb. I beam on a 21-ft. span has a load-carrying capacity of 30,000 lb. This is on the basis of 16,000-lb. tensile strength. If anyone desires to check the accuracy of this shortcut let him try it with any Am. Std. beam and then compare results with the handbook data prepared by the aid of highly involved mathematics.

A. W. K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

Organized Maintenance Keeps Machinery Running

By A. HECKMAN, Works Engineer
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

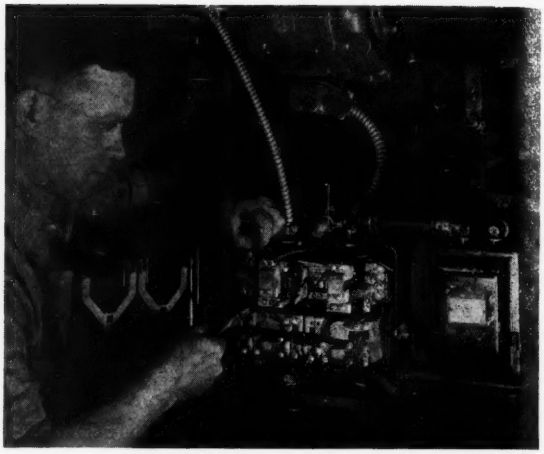


Fig. 1. Regular inspection of motor linestarters reduces time outages

MAINTENANCE departments in industry have a vital responsibility in our war effort to keep hard pressed equipment in operation during the 168-hr. week now in force in most plants. This has increased the maintenance problem many times and those who are responsible must think fast and keep prepared for any eventuality that might happen and take care of this condition in the shortest possible time with the least interference of our production schedule. We not only consider machine tools, but also consider our power plants supplying steam and compressed air to the many tools in our shops as this service is equal in importance to maintaining machine tools and allied equipment. For instance, it would do little good to have machine tools in A-1 condition only to be shut down due to a breaker failure in the electrical circuit.

Our main plant is equipped with: approximately 17,000 motor driven machine tools of all types which vary in size from the smallest to the largest in the United States; 200 overhead traveling cranes with capacities of 2 to 50 t.; and 250 electric hoists with capacities of 0.5 to 3 t. mounted on jib cranes and monorails. All of this equipment is housed in buildings having a total floor area of 4,500,000 sq. ft., located in a 77-a. area. Equipment must be maintained to a high standard and we have set up a system that meets these demands with very little interference with production. The scheme of operation depends entirely upon a thorough inspection setup; since the finding and correction of minor troubles prevent the occurrence of major ones. This is called preventative maintenance.

The plant is divided into five separate divisions: Motor; transportation and generator; switchgear; feeder; and factory service. Each division maintains its own machine tools and manufacturing equipment, except where the repair is too large in which case they call upon the factory service division to make the repair.

In each of the divisions listed, a tool supervisor is responsible to the superintendent of the division for keeping all equipment fit to meet the production schedules. Each supervisor has his own tool maintenance department with several inspectors who are continually inspecting machines. All tools are checked monthly for any defects that may have occurred, and observations are made on an inspection card made out in duplicate.

One copy of the inspection report is sent to the foreman of the department where the inspected tools are located, another goes to the foreman of the tool maintenance department. If a defective part is found, and it needs immediate attention, the repair will be made at once. If, in the judgment of the inspector and maintenance foreman, the repair can be made at some predetermined shutdown period, such as lunch time, change of shift, or change of setup, it will be made at that time.

From these many inspections, the tool maintenance foreman has gained a vast amount of information about the weakness of each tool, and has stocked in his department repair parts to take care of any replacements. However, there are some cases where we do not have the necessary part and the machine may then be kept in service by temporary repair, or the part may be made by our tool repairman. The policy is, however, to buy repair parts from the manufacturer who supplied the machine.

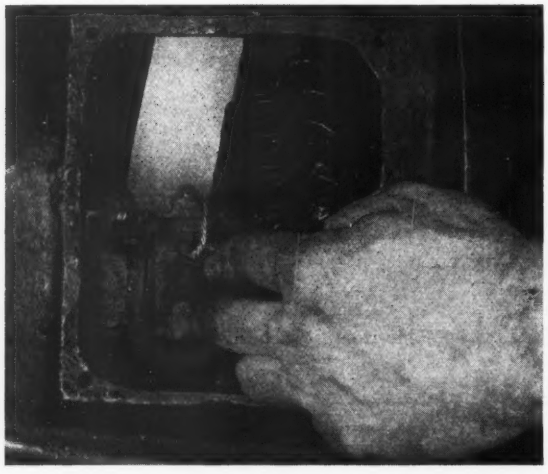


Fig. 2. A thorough motor maintenance program does not neglect brushes. The proper method of cleaning and surfacing is to press the brush down on a strip of sand paper placed between the brush and the commutator. The sand paper is then pulled in the direction of commutator rotation. Several passes, depending on the brush condition, should be sufficient

Fig. 3. Oiling the motor regularly is essential to a long bearing and shaft life. The oil level gage held in the operator's left hand indicates the proper amount. Too much oil may contaminate the motor windings and cause deterioration of the insulation

Fig. 4. It is essential to keep a motor clean by using a suction hose or by blowing with an air line. Although a metal cover (removed) gives some protection to this motor installed on a carpenter's saw, sawdust will get to the windings and should be removed before it bakes on

From time to time, machine tools are taken out of the production line for rebuilding or a general overhauling. How often this may be done is determined by how hard the machine tool has been used. The operator of each machine tool oils his machine, and monthly checks are made by the inspector. Similar inspection reports are made for shapers, turret lathes, drill presses, punch presses, shears, etc.

All motors and controls for machine tools are inspected, repaired, cleaned and oiled by electricians known as "trouble shooters". These men have their zones laid out and are continually on the alert to keep the electrical equipment in their zones in good working condition. If an unusually large amount of electrical trouble occurs in any particular zone, we can point our finger of scorn at the trouble shooter in that zone and tell him to get busy. With this setup, we have had very few electrical breakdowns.

Heterodox Tube Cleaning. II[1]

Air Driven Tube-Cleaner Motors And Operating Auxiliaries

By ATOMIZER JOHN

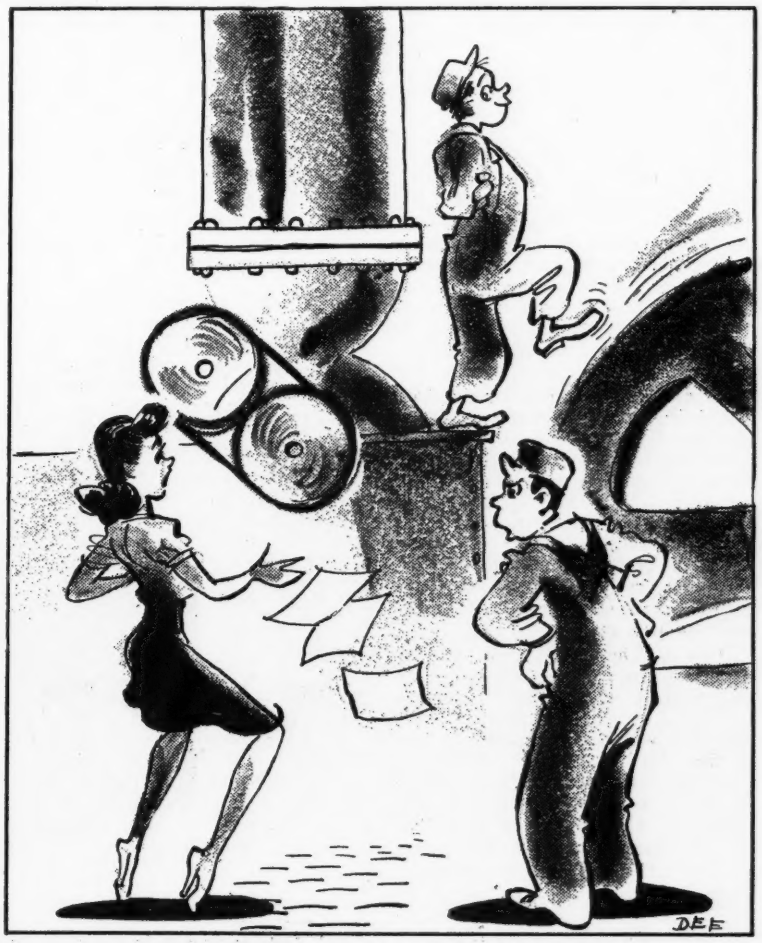
HEAT TRANSFER equipment down-time must be cut to a minimum, if the war production schedule is to be maintained. Efforts should be redoubled to eliminate the causes of scale deposits; when this has been brought to practical perfection the next step is to provide adequate methods or tools to remove the scale deposit rapidly with no detrimental damage to the vital tube structure or surfaces.

This can be best done by turning an intelligent spotlight on the tube cleaning or 'black gang' crews and equipment and carefully studying why this one expensive, important phase of American Industries has been allowed to lag so far behind industrial progress that its investigation will cast reflections directly on the intelligence of many plant managers.

The prime mover or heart of all tube cleaning is the tube cleaner motor; unless it is maintained in almost perfect condition, supplied with sufficient volume and pressure air and properly lubricated, tube cleaning will be handicapped from the very start. The fact that tube cleaner motors are given the most severe service of any tools in a plant is ample reason for recommending that they be given the most severe servicing possible.

If more engineers, managers and tube cleaner operators knew the tolerances allowed in design and manufacture of tube cleaners to develop maximum power for this type of machine, it would eliminate field repairs by the 'black gang' on tube cleaning motors. Regardless of the comments which will be made on the following statement, it has been definitely proven that maximum tube cleaner efficiency cannot be economically maintained unless wearing parts are renewed and discarded on micrometer readings only.

This may come as a blow to some who have always considered that anyone can run and repair a tube cleaner motor. Many people up to and including some who sell tube cleaning equipment will pass a motor as in excellent condition so long as they are unable to pull the shaft out through the front bearing. This is just one of the fallacies which has been allowed to exist among tube cleaner users, others will be pointed out later in the discussion.



"Don't worry about him Miss, he just likes to tease."

[1]Part I appeared on p. 93 of the October issue. This was originally intended as a series of six articles but the author is now in the Army. The remaining four parts covering: Drills and Cutter Heads; Technical Data and Information; Care of Equipment; and Supervision and Use of Equipment will appear as the author has opportunity to complete them.

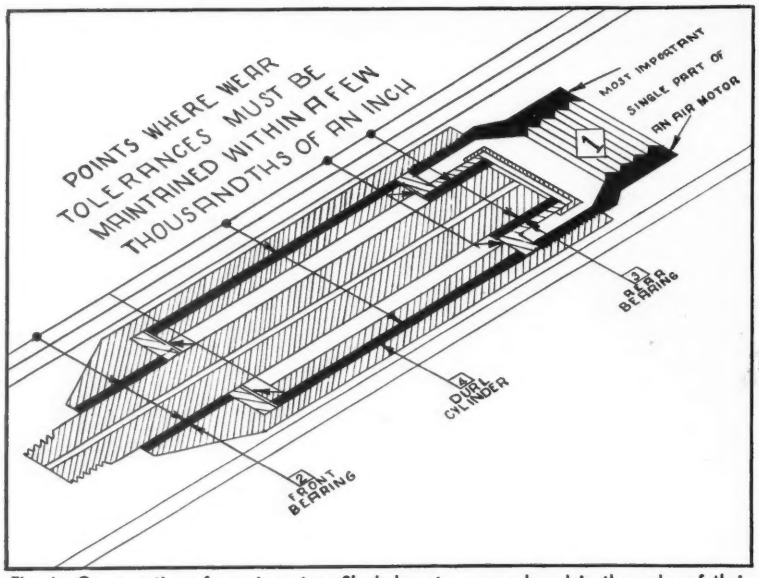

POINTS WHERE WEAR TOLERANCES MUST BE MAINTAINED WITHIN A FEW THOUSANDTHS OF AN INCH
MOST IMPORTANT SINGLE PART OF AN AIR MOTOR
REAR BEARING
DUAL CYLINDER
FRONT BEARING

Fig. 1. Cross section of an air motor. Shaded parts are numbered in the order of their importance and are explained in the text

Figures 1 and 2 show the general construction of a dual cylinder multivane air driven motor. Made up as a composite sketch, it does not represent any single make of motor. In Fig. 1, the parts numbered are:

Part 1. The coupling which screws into the back end of the motor and is the most important part of an air driven motor. For unless it is maintained perfectly solid against the forward parts of the motor rapid wear of parts and ultimate self destruction of the motor will result. For tightening these couplings it has been found the following length of wrenches work very satisfactorily when applied with a medium pull

Motor O.D. 2 to 3 in. use a 14-in. wrench
Motor O.D. 3 to 5 in. use a 18-in. wrench
Motor O.D. 5 in. or over use a 36-in. wrench

When tightening a coupling the shaft should be turned constantly to insure its free action. In case the shaft locks before the coupling is considered tight, do not attempt to free the shaft by turning it by force or running it with air. Pull the motor apart and lightly blue the end of the vanes, shaft and plates, reassemble and tighten coupling until the shaft starts to lock; work shaft until parts are marked; disassemble, and inspect for long parts.

Part 2. The front bearing, whether steel or bearing metal, is subjected to the most severe service possible. It must be maintained within a few thousands clearance or it will permit the shaft to drag on the cylinder which will quickly ruin the efficiency of the motor. The clearance between a new shaft and bearing may vary from 0.0005 to 0.0015 in. When wear increases this to 0.006 in. it is advisable to change the front bearing or shaft, or both, to bring this back to the original tolerance. Proper lubrication will permit the air motor to run as much as 16,000 lineal feet of hard cleaning before it is necessary to change either part (bearing or shaft).

Part 3. The rear bearing gives between 4 to 6 times the length of service obtained from the front bearing, provided the motor is properly lubricated. The rear bearing will usually fail by wearing out of round opposite the point of maximum power development during the cycle.

Part 4. The dual cylinder will wear directly proportional to the type of lubrication used providing the front and rear bearing clearance is kept below 0.006 in. There is only approximately 0.004 in. clearance between the enlarged sections of the shaft and the dual cylinder exhaust ridge. As this clearance increases loss of power increases more than 11 per cent per 0.001 in. wear.

The effects in efficiency of wear on the end slide plates and blades are indeterminate so long as they wear uniformly. The limiting factors are when the slide plates permit the shaft to develop appreciable end play and the contact edges of the blades become uneven; then the parts should be renewed. There is an erroneous practice of changing vanes and slide plates first when troubles in power development are experienced.

Figure 2 shows the simple arrangement of the shaft, vanes and cylinder of an air driven tube cleaner motor. On Fig. 2B points 2 show the exhaust ridge which has only 0.004 in. clearance between the shaft and cylinders. On Fig. 2A points 1 shows how the exhaust ridges will wear when too much clearance is permitted in the front or rear bearings. M shows, on a 4-vane motor, where the maximum power is developed and it is opposite these points where maximum wear will take place on the rear bearing.

The manufacture of air driven tube cleaner motors and repair parts requires precision tools and highly skilled labor which is now also working on essential war materials, so taking special care of the tube cleaner motors also helps in our unified war efforts. Also it will be possible to make a drastic reduction in unit down-time if the motors are driven at maximum design speed and power.

For maximum tube cleaner motor results the following prerequisites must be observed:

1. The air pressure must positively be maintained between 80 and 105 psi at the back end of the motor. The air header pressure must be maintained high enough to overcome the 16 to 50 psi pressure drop through the tube cleaner hose and lubricator.

2. The moving parts of the motor should turn easily by hand yet the lock coupling must be jammed rigidly down against the stationary parts.

3. Tube cleaner motors turning over at 3000 r.p.m. must actually be flooded with lubricating oil spray. In tests it has been found steel to steel bearings wear as much as 17 times as fast with improper oil as they do with proper lubrication. Instead of using a good S.A.E. 40 oil it is necessary to have a compounded oil, which will resist oxidation and will not lose its lubricating qualities when emulsified with water vapor.

4. Do not count lubricating oil drops

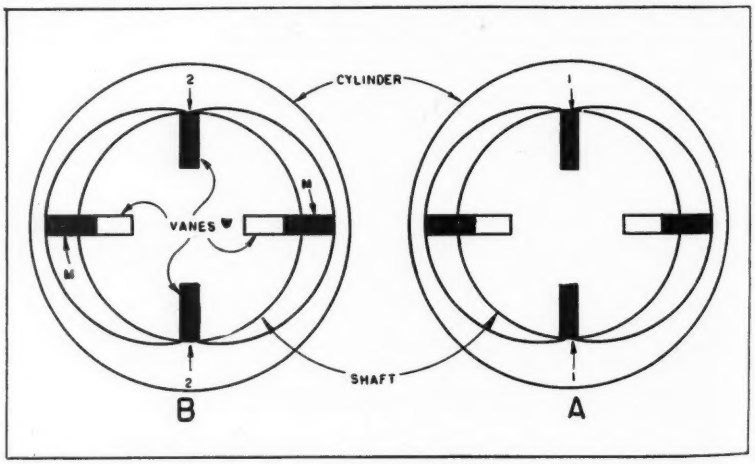


Fig. 2. Sketches showing the simple arrangement of the shaft, valves and cylinder of an air driven tube cleaner motor

through the opening of a lubricator, put enough oil through the motor to have a film of oil always showing on the exhaust parts of the motor.

5. All wearing parts should be checked with micrometers and kept within allowable tolerances, hence hard to get dynameter tests will not be necessary to insure maximum power performance.

Rewiring for Commercial and Industrial Buildings*

PART 3

Continuing the discussion of the use of small diameter building wires in adapting existing electrical systems to increased loads started in the first two articles of these series, in this third article detailed consideration is given to the redesign of branch circuits. The small diameter building wires are particularly adapted to the rewiring of branch circuits because such circuits usually involve some very small conduits

UNTIL the advent of small diameter building wires the final branch circuit was usually the cause of the most trouble and expense when rewiring was undertaken. This was because the embedded conduits were usually the small ½ and ¾-in. sizes, and frequently contained the maximum number of wires.

Now it is possible to rewire these existing conduits with small diameter wires. The electrical capacity can thereby be increased two or three times and the voltage drop also decreased as compared with the original installation.

The basic 2-wire 115-v. circuit has been widely used because of its extreme simplicity, even when two or more circuits occupied the same conduits. Other circuit arrangements are more efficient, and are readily usable for commercial and industrial rewiring. The choice will depend in some degree upon the type of electrical service available in the building. The most common multi-wire circuits are as follows:

1. Three-wire 115/230-v. a.c. or d.c. See Fig. 3.
2. Four-wire 120-208-v. Three-Phase. See Figs. 4 and 5.
3. Five-wire 115/230-v. Two-Phase. See Fig. 6.
4. Three-wire 115 or 230-v. Three-Phase. See Fig. 7.
5. Combinations of two or more of these multi-wire circuits either with individual or common neutral wires.

Multi-wire branch circuits are covered in Section 2104 on page 27 of the 1940 N. E. C. Heretofore, the maximum number of wires permitted in small size conduits has limited the use of many of the foregoing combinations. The use of Small Diameter Building Wire makes multi-wire circuits especially advantageous, with the result that the following factors all contribute to the increased capacity of branch circuits:

1. Larger sizes of copper wires with thin-wall insulation.
2. Larger number of wires in conduit resulting from smaller overall diameters of wires and from increased conduit fill.
3. Multi-wire circuits.

Examples of Rewiring with Multi-Wire Branch Circuits

To indicate the possibilities of rewiring the following illustration may serve as a typical example: Assume a 40 ft. run of ½-in. conduit containing four No. 14 Type R wires (the maximum heretofore permitted). This formed two 115-v. circuits with a maximum of 15 amp. per circuit. The maximum capacity was 1725 w. per circuit or 3450 w. total. The voltage drop was excessive, amounting to 2.8 per cent or 3.2 v. at full load.

In rewiring this typical circuit several alternatives are possible. The simplest arrangement would be replacement with four No. 10 small diameter wires. Any of the four types RPT, RHT, RU, or SN (see Table 1) may be used, but assume that Type RHT has been selected. No. 10 RHT is rated at 37 amp., but since four wires are run in the same conduit, this rating is reduced to 80 per cent or 29.6 amp., which is to be compared with original 15-amp. rating. The new capacity is 3404 w. per circuit, or 6808 w. total. The voltage drop is 2.2 per cent or 2.5 v.

However, the use of four wires is somewhat inefficient, so assuming that the rewiring plan provides for 115/230-v. service, the two original 115-v. circuits may now be replaced by a 3-wire 115/230 v. circuit. The three No. 10 RHT wires are now rated at their full 37-amp. capacity, and the capacity is 8510 w. total. With the load balanced between the two ungrounded wires, the neutral carries no current and the voltage drop is only 1.3 per cent or 1.5 v.

But the ½-in. conduit will accommodate a maximum of six No. 10 RU or SN wires. These six wires may be arranged as two entirely separate 115/230-v. circuits; No. 10 RU and SN is rated at 31 amp., but since four ungrounded wires are run in the same conduit, this rating is reduced to 80 per cent or 24.8 amp. The new capacity is 11,408 w. total. The voltage drop is now only 0.9 per cent or 1.04 v. when the load is balanced. Even with complete unbalance of load, the maximum voltage drop is only 1.8 per cent.

These three alternatives for rewiring a 40-ft. run of ½-in. conduit is summarized in Table 7.

Even these alternatives do not exhaust the possibilities, many other useful and practical combinations are available.

Saving Volts with Multi-Wire Circuits

When 2-wire circuits are used, both the ungrounded wire and the grounded wire carry the same current, and the total voltage drop results from the current passing through the combined resistance of both wires.

The use of multi-wire circuits not only saves the use of one or more wires that would be required for the equivalent 2-wire circuits, but what is even more important is the reduction in voltage drop.

In the foregoing summary, Alternative No. 1 consists of two 2-wire circuits and uses 4 No. 10 wires as compared with 4 No. 14 wires in the original installation. The slight reduction in voltage drop from 2.8 to 2.2 per cent is a result of the increased wire size. Alternative No. 2, using 3 No. 10 wires, is the exact equivalent of Alternative No. 1 except that the two grounded wires have now been combined into a single "neutral" wire. Under balanced conditions of load on the two sides of the circuit the return currents exactly balance or cancel each other with the result that the neutral carries no current, and voltage drop now results from the current passing

Table 4[1]. *Maximum number of wires for rewiring small conduits

Size Conduit	Wire, Awg.	Number of Wires in Conduit: Types R, RP, RH & RW	Types RPT & RHT	Types RU & SN
½-inch	14	4	7	9
	12	3	5	8
	10	1	4	6
	8	1	2	3
	6	1	.	1
¾-inch	14	7	9	9
	12	5	9	9
	10	4	8	9
	8	2	4	6
	6	1	.	3

*Nine wires are the maximum permitted in raceways, except in special cases of signal and control units. Types R, RP, RH & RW are available in the complete range of wire sizes. Type SN is available in sizes Nos. 14 to 0000 Awg. Types RPT & RU are available in sizes Nos. 14, 12 & 10 Awg. Type RHT is available in sizes Nos. 14, 12, 10, & 8 Awg.

*Abstracted by special permission from a booklet by the same name published by the Wiring Sales Committee of the Edison Electric Institute.

[1]Tables 1 to 3 appeared in Parts 1 and 2.

Table 5. Number of wires required for various circuits

Type of Circuit	Number of Wires Required 1 Circuit	2 Circuits	3 Circuits	4 Circuits
Simple 2-Wire Circuit:				
2-Wire 115-V., A.C. or D.C.	2	4	6	8
Multi-Wire Circuits:				
3-Wire 115/230-V., A.C. or D.C.	3	6	9	
3-Wire 115 or 230-V., 3-Phase	3	6	9	
4-Wire 120-208-V., 3-Phase	4	8		
5-Wire 115/230-V., 2-Phase	5			

Table 6. Rewired circuits for ¼-in. conduit

No. & Type of Circuit	No., Size & Type Wires	Current, Amperes	Watts, Total	Circuit Length for 2% Drop, Feet
4 2-W. 115-V.	8 No. 12 RU or SN	16.1	7,406	43
2 3-W. 115/230-V.	6 No. 10 RU or SN	24.8	11,408	89
2 3-W. 115-V. 3-Ph.	6 No. 10 RU or SN	24.8	19,736	101
2 4-W. 120/208-V. 3-Ph.	8 No. 12 RU or SN	18.4	13,248	78
1 5-W. 115/230-V. 2-Ph.	5 No. 10 RHT	29.6	13,616	74

through one wire instead of two. Thus under equal loads, voltage drop in Alternative No. 2 is exactly half as much as in Alternative No. 1. Even when the loads on the two sides of a 115/230-v. 3-wire circuit are not balanced, the neutral wire carries only the difference in current in the two ungrounded wires. Since this difference in current is usually small, the drop in the neutral wire is likewise small. Even with complete unbalance, such as half the total load concentrated on one side of the circuit, voltage drop is then the same as in a simple 2-wire circuit, but the cost of one wire and the space it occupies have been saved.

In laying out branch circuits four principal elements are involved. The type of service available and the loads to be served are relatively fixed conditions. In new work the kind of circuits to be employed and the sizes of conduit are then selected with the view of the best overall economy.

In rewiring, the sizes of existing conduits and the loads to be served are the governing conditions. The kinds of circuits will depend in some degree upon the available types of service, and these two elements must be adjusted to meet the fixed conditions.

Perhaps the most important factor to be considered at this point is the number of wires of each size and type that may be run in a given size of conduit. Complete data on conduit fills are given in Tables 4 to 11 on pages 305-311 of the 1940 N. E. C. However, the following condensed Table 4 is arranged to show the comparative number of wires that may be used in ¼ and ¾-in. conduit for branch circuit wiring.

Tables 4 and 5 may be used together to determine practical circuit combinations. For example, from Table 5, two circuits of 3-wire 115/230 v. require six wires. Referring to Table 4, a maximum of seven No. 14 RPT or RHT, or six No. 10 RU or SN wires may be used in ½-in. conduit.

A few of the maximum combinations for ½-in. conduits are shown in Table 6.

Common Neutral for Multiple Branch Circuits

When two or three branch circuits are run in the same conduit, it is entirely practical to combine the neutral conductors of the individual circuits into a single "common" neutral. This results in economy in the use of wire, and in some saving in space in the conduit which facilitates the installation. In some cases it will permit the use of larger wires with correspondingly greater capacity.

The use of common neutral can be particularly advantageous in rewiring, but it is usually necessary to obtain the approval of the local inspection authority in order to make use of it.

When multiple circuits are arranged so that the load will always be balanced, such as by the use of 2-pole switching on 3-wire 115/230-v. circuits, the common neutral wire may be the same size as the ungrounded wires. Otherwise, the common neutral should be of sufficient size to carry the neutral current which might result from maximum unbalance of the load.

Table 7. Three alternatives for rewiring a 40-ft. run of ½-in. conduit

	Original Installation	As Rewired Alternative No. 1
No. and Size Wires	4 No. 14 R	4 No. 10 RHT
No. of Circuits	2 115 v.	2 115 v.
Max. Amperes	15	29.6
Total Capacity, Watts	3450	6808
Voltage Drop, Per Cent	2.8	2.2

	As Rewired Alternative No. 2	Alternative No. 3
No. and Size Wires	3 No. 10 RHT	6 No. 10 RU or SN
No. of Circuits	1 115/230 v.	2 115/230 v.
Max. Amperes	37	24.8
Total Capacity, Watts	8510	11,408
Voltage Drop, Per Cent	1.3	0.9

How Much Oil In Your Tanks?

THE BURNING question today, in the 30 states where fuel oil is rationed, is "how much of my fuel oil allotment should have been used during the past 60 days?" It is important to have the right answer.

The OPA has announced that it will issue weekly reports in 103 cities, showing the maximum amount that a home owner should have burned in terms of percentages for each one of the five heating periods. For the first period ending November 30, the figures for Zone A are as follows:

Zone A (Oct. 1—Nov. 30, 1942)

	Normal Degree Days	1942 Degree Days	% of Normal
Bismarck, N. D.	1666	1555	93.3
Pierre, S. D.	1330	1320	99.2
Minneapolis, Minn.	1429	1289	90.2
Green Bay, Wisc.	1383	1349	97.5
Sault Ste. Marie, Mich.	1584	1570	99.1
Lansing, Mich.	1275	1214	95.2
Burlington, Vt.	1555	1290	83.0
Concord, N. H.	1312	1261	96.1
Portland, Me.	1248	1298	104.0

As the weather has been variable in some localities, oil consumption in the first period should have ranged from 17 to 24 per cent of the total oil ration.

These percentages are of little value to the home owner unless some procedure is provided for him to personally check the amount of fuel oil in his tank. A simple chart has been devised by Walter L. Fleisher, New York consulting engineer and member of the War Service Committee of the American Society of Heating and Ventilating Engineers, to help the fuel oil user check his oil consumption. The chart may be found on the last page of this section.

By the use of an inexpensive collapsible 6-ft. rule, which anyone can use, it is possible to measure the depth of oil in the tank. With this information and the detailed instructions given on the accompanying chart, one can readily estimate the number of gallons left in the tank and determine the amount of oil used in the period of time covered by the fuel ration coupons.

Test 2000 Plants for Rubber

NEARLY 2000 varieties of plants found in this hemisphere have been tested for rubber since March, 1942, by investigators of the department of agriculture at Cornell University, Ithaca, N. Y., working with the B. F. Goodrich Co., Akron, Ohio.

In a new process, only 5 min. are required to give an approximate idea of the natural rubber in plant tissues, the university reports. The Russian dandelion appears to be the most promising emergency rubber-bearing plant for growth in the North. The rubber content of this plant can be easily obtained by mechanical means and after rubber is extracted from the roots they can also be used for alcohol production.

How Would You Do It?

PROBLEM 26—Does the 65 deg. ruling save fuel? Most of the answers agree that it does. But they nearly drove the old judges crazy trying to figure out how much. Most important of all, the judges want to know how you can convince the ladies that they can exist in a house where the temperature is only 65 deg. F.

Here is what the judges left us with—and may Heaven have mercy on their souls!

FIRST PRIZE AWARD
Rollin A. Lager
Milwaukee, Wis.

THE TWO QUESTIONS involved in Problem 26 are interesting, but when no less an authority than the Bureau of Mines supports the claims that lowering inside temperature saves fuel the question should be properly settled. However, for those skeptics who want some added proof I may be able to present it in a little different light.

The question of whether or not fuel can be saved by lowering the inside temperature 5 deg. or more is the easier one of the two to settle.

Heat load of a building can be reduced to one simple equation by reducing all factors to equivalent air changes per hour. The equation becomes: H.L. =

B.Vol. × N × 0.24 × 0.075 × (T-t)

Where:

H.L. = heat load in B.t.u./hr.

B.Vol. = volume of heated space in cubic feet.

N = equivalent number of air changes per hour.

0.24 = specific heat of air

0.075 = density of air in pounds per cubic foot.

T = inside temperature in deg. F.

t = outside temperature in deg. F.

It can be seen that for a given set of conditions the only variable is the inside temperature. By eliminating the constants and comparing two conditions the per cent of saving becomes:

$$\text{Per cent Saving} = 100\left[1-\frac{\text{H.L. at 65 deg.}}{\text{H.L. at 70 deg.}}\right]$$

Assuming a set of conditions as 1000 cu. ft. vol., one air change per hour, and 0 Deg. F. outside temperature, the equation becomes:

$$\text{Per cent Saving} = 100\left[1-\frac{1000\times0.24\times0.075\times(65-0)}{1000\times0.24\times0.075\times(70-0)}\right]$$

which reduces to:

$$100\left[1-\frac{65}{70}\right] \text{ or:}$$

100 (1 — 0.9285) or: 7.15 per cent

The *heat* saved at 0 deg. F. outside temperature is 7.15 per cent. This divided by the efficiency of the heating system expressed as a decimal gives the per cent of *fuel* saved.

Figure 1 shows how the *per cent* of *heat* saved varies with the outside temperature. The saving reaches 100 per cent at 65 deg. F. because at this point no heat is required inside of the building, and the per cent of saving is represented by $100\left[1-\frac{0}{70}\right]$ which is 100.

It is interesting to note that the per cent of saving is greatest on mild days. Since fuel oil rationing is based on an overall reduction of 15 per cent or more, it behooves home owners burning oil to keep the thermostat set at 60 or 65 deg. F. even on mild days so that they will come out even.

We can now proceed with the question of lowering the thermostat setting over night. The advantage in doing this cannot be so easily shown nor can an answer be given which will cover all conditions. The crux of the matter is in *the efficiency of a given heating system.* When two men argue this issue and base their arguments on their own experience both *can* be right. To show how this is possible, following are a few governing premises:

(1) It has just been shown that it takes less heat to keep the inside of a building at 65 deg. than at 70 deg.

(2) During the hours the building is held at 65 a fuel saving is realized.

(3) It cannot take any more *heat* in the morning to restore the temperature to 70 deg. than was lost by the building in dropping from 70 to 65 the night before.

(4) The heat lost by the building in cooling from 70 to 65 at night re-

(*Continued on page 94*)

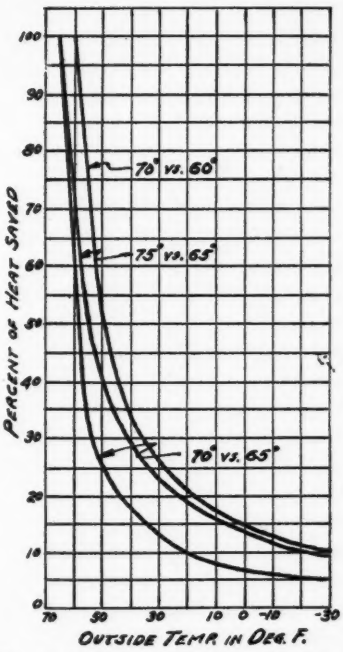


Fig. 1. Curves showing how per cent of heat saved varies with outside temperature

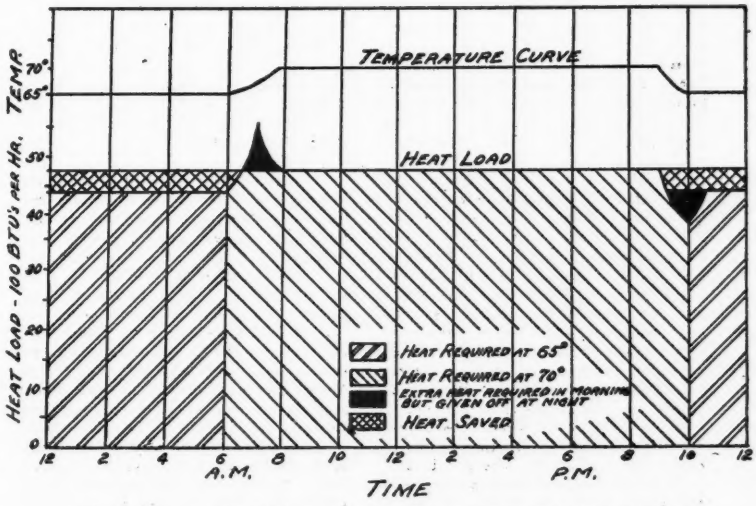


Fig. 2. Diagram showing how reduction of temperature at night saves heat

H.L. at 65 deg. = 4420 B.t.u. per hr.
H.L. at 70 deg. = 4760 B.t.u. per hr.
Saving (4760 — 4420) × 9 or 3060 B.t.u.
If the temperature were not lowered the heat required during the 24 hr. period would be 4760 × 24 or 114,240 B.t.u.

$$\text{Per cent of heat saved is } \frac{3060}{114{,}240}\times 100 \text{ or } 2.68 \text{ per cent}$$

Assuming heating plant efficiency at 60 per cent

$$\text{Fuel Saved is } \frac{2.68}{0.60}\times 100 \text{ or } 4.47 \text{ per cent or about } 4\tfrac{1}{2} \text{ per cent}$$

Problem 27

STEAM DRIVEN AUXILIARIES Vs. ELECTRIC MOTORS

OUR HERO is anything but hidebound. When he encounters a really good problem, he never hesitates to relinquish his own picayunish enigmas and give space to the worthwhile one, even if, as in this case, it takes an entire page. For some reason Our Hero found it necessary to go to Florida at this particular time of the year, and while we suspect it was not a business trip we can't prove it. While there, however, he ran into George P. Graves of Ft. Lauderdale and Mr. Graves, it seems, had a problem which intrigued Our Hero's fancy—that is, he fancies we can solve it for him. So he sends it in air mail, verbatum, and since we cannot answer it, we pass it on to you.

Mr. Graves, who incidentally is one of our good subscribers, has been troubled by a question of plant operation and his opinion of it differs radically from that of his associates. He wants to know what others think of it. It is not a new question, indeed it is one which has been discussed many times before in magazines and at engineering meetings, but since it happens to be a very real problem for Mr. Graves and one, if it can be answered correctly will benefit his company, we present it here.

Here is Mr. Graves' statement.

We have a problem in which we all do not agree in regard to just when to cut in steam driven auxiliaries.

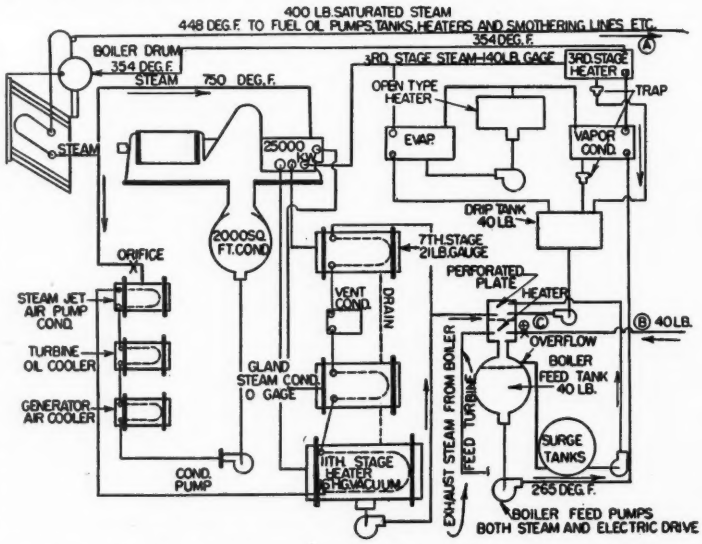
Between the hours of 1:00 a. m. and 6:00 a. m. our load is very light and we try to keep all equipment in service to minimize thermal stresses as it has to be in service again at 7:00 a. m. During these 4 to 5 wee hours of the morning our temperature continues to drop in our boiler feed system.

We extract steam for heating boiler feed with closed type heaters and provide steam for the coils of our evaporators only. Our boiler feed tanks and surge tanks gradually cool down until at the above hours they approach atmospheric pressure and 212 deg. F. temperature. We have proved by 16 yr. practice at this plant that pressure above atmospheric must be maintained.

About 1:00 a. m. our trouble begins when our boiler feed system approaches atmospheric pressure as above stated. We operators are about equally divided on just what procedure to follow to maintain the pressure safely above atmospheric. My experience has taught me, and reading from trade magazines the experience of a large number of others along the same line that the use of steam driven auxiliaries is recommended as long as all of the exhaust steam can be successfully utilized in heating or in process work. The opinion of various authors on steam engineering agree with me on the above subject.

We are equipped with both electric and steam driven boiler feed pumps all in good condition. The steam driven unit exhausts directly into our boiler feed tank which is directly connected to our surge tanks. This exhaust is ample to satisfy all requirements about boiler feed system and sometimes a little more.

When the exhaust steam from our boiler feed pumps exceeds the requirements for heating and pressure in boiler feed system it is time to cut in our electric motor driven boiler feed pumps.



Sometimes when the load is so near the breaking point between the two systems of operation, say, too much exhaust steam to supply the demand of the boiler feed tank temperature and pressure and too low without it, is the time I suggest throttling the seventh stage extraction bleeder. I would just pass enough steam to the seventh stage heater that the temperature of the water leaving the heater when entering the boiler feed tank would just carry about 5 lb. pressure in that unit or safely above the atmospheric. As load increased cut in electric driven pumps as the temperature and pressure increased in boiler feed tank. While throttling the seventh stage the pressure and temperature in the boiler feed tank can be kept just where wanted with little attention, permitting the remainder of the steam to continue through the prime mover doing useful work.

My associates advocate letting the 500-hp. electric driven boiler feed pump run day and night regardless of load, saying the current doesn't cost us anything as we make it when the generators are running practically idle. They insist on drawing 400 lb. saturated steam directly from our boilers (see A on sketch) which has done no useful work and carry it 800 ft. and through two reducing valves (400 to 150 and 150 to 40 lb.) and a throttling valve into boiler feed tank to maintain the required temperature and pressure. This long tortuous line leaving the building is ½-mi. long and is used to save the exhaust from duplex fuel oil pumps, supply smothering lines required by underwriters in case of fire in or about tanks, carrying the required temperature for the oil at the burners, etc. It has two reducing valves one 400/150 lb., for use in duplex pumps and 150/40 lb., for use as required by underwriters. From 1:00 a. m. to 6:00 a. m. no outside pumps are used therefore the long all purpose line stands with 40 lb., pressure on it, thus this line is the one they propose to use for maintaining the pressure in boiler feed tank, however, only about 800 ft. of it is to be used. (A) on sketch is where the 400 lb., saturated steam leaves the plant and (B) is where the 40 lb., steam re-enters the plant (C) is the throttling valve.

My associates, insist that I am using expensive superheated steam at about 750 deg. F. and they use 450 deg. F. saturated steam. Just what difference does it make when we have an abundant supply of both kinds at that hour of the morning and every B.t.u. is utilized in both cases except what they waste carrying it 800 ft. through questionable insulated pipe lines.

They are also cutting out two expensive reducing valves which are a prolific source of trouble anyway, as well, as wire drawing and cutting out a throttling valve at boiler feed tank. I insist they are using steam directly off the boiler which has done no useful work, and I am using exhaust steam to do the same work, and stopping a 500-hp. motor in the meantime.

I am an enthusiastic advocate of using steam driven auxiliaries in both central stations, as well, as industrial plants where all the exhaust steam can be utilized for heating and process work. The most economical use of the low-pressure turbine wasting 70 to 75 per cent of the heat to the circulating water cannot equal the practical use of the exhaust steam where every B.t.u. is utilized as I have above suggested.

Write your opinion of this problem in a letter of 1500 words and send it to the Contest Editor by March 31. A $25 War Bond will be awarded for each of the two best letters and a third prize of $10 in cash will be awarded for the third best letter. The letters will be judged on the basis of accuracy in adhering to the conditions set forth in the problem, clearness and simplicity of the analysis and soundness of argument. The opinion of the judges will be final.

Entries in this contest should be marked Problem 27 and should be addressed, Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.

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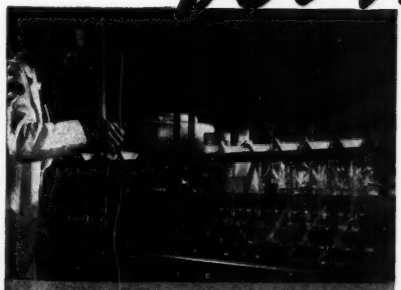

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duces the heat demand from the heating system at the time and is balanced by an equal amount of extra heat demanded from the system in the morning to restore the temperature.

(5) If the heating system capacity is so small that it has to be forced greatly, its efficiency during the period of high output may be so low for several hours that the loss of heat to the chimney exceeds the saving which was realized the night before and no *fuel* is saved.

(6) Usually the only condition under which a heating system has to be pushed to the limit to replace the heat lost in lowering the building temperature over night is that existing during the peak demand days in which the outside temperature dips abnormally; this occurs only occasionally.

A little study of Fig. 2, adopted from the textbook "Heating and Air Conditioning" by John R. Allen and James Herbert Walker and revamped slightly to fit the particular conditions used to illustrate the answer to the first question, will convince one of the possibility of a saving. The most conclusive proof, however, comes from the long established practice of banking a coal fire at night. People who are hand firing and have no automatic damper controls almost invariably close their furnaces off at night. They would not be willing to tolerate a cold house in the morning if it were not for the fact that the practice reduces their coal consumption. The same laws govern whether a heating plant is hand fired or automatic or whether it is coal, oil, or gas fired.

If cutting the inside temperature to 60 or 65 deg. creates trouble in end rooms, the trouble can probably be corrected by some change in the heating system or method used to lower the temperature in the main part of the building.

SECOND PRIZE AWARD

E. F. Sibley
East Haven, Conn.

IF THE PURPOSE of heating a building were just that and no more, there should be little question or discussion as to the economy of heating to various temperatures. Every engineer knows that the hotter a fire under a boiler the faster he can make steam. Every housewife knows that the hotter her stove or the fire under her pots and pans, the more rapidly she can cook a meal. From our everyday experiences we know that heat flows from a hot object to a cold one. We also realize that as the temperature difference becomes greater between the source of heat and the thing being heated, the rate of heat movement increases.

When our homes, stores and factories are the source of heat and the great outdoors the thing being heated, there should be no question but that the colder it is out of doors or the warmer it is indoors the faster heat will move out of the house. More fuel will then be required to replace the heat loss and maintain the building temperature.

Getting down to facts and figures, building heat losses are figured as conduction or convection losses. Radiant heat losses are relatively small.

Both conduction losses and convection heat losses are proportional to the difference in inside and outside temperatures. If we assume an outside temperature of 30 deg. F. and an inside temperature of 75 deg. F., our temperature difference causing a heat flow would be 45 deg. F. On the other hand if our inside temperature was 65 deg. F. the temperature difference would be 35 deg. F. The heat flow in the two cases would be as 35 is to 45. The difference in the so-called temperature heads or 45 — 35 = 10 deg. F. This, divided by the initial temperature difference or 45 deg. F. would give

$$10 \div 45 = 22.2$$

per cent as the decrease in heat loss. This should theoretically also be the fuel saving.

The physical laws on which heat losses operate work just the same at night as in the daytime, so even greater savings can be effected with lower night temperatures. One wonders why some people question the merit of lowering temperatures at night and raising them again in the morning. Certain it is that large office and apartment buildings have made worth-while, substantial fuel cost savings by reducing building temperatures at such times as higher temperatures were not necessary. Elaborate and costly control and monitor systems have paid for themselves many times over in a few years' time and tenant satisfaction has improved.

There are, however, many things to be taken into consideration in changing building temperatures. One disadvantage of allowing a house or building to cool off over night is the difficulty of warming it up again in the morning. The furniture and walls of the rooms, having cooled off, must take on again the heat they gave up during the night. This sometimes requires, while the walls are absorbing heat, a considerable excess capacity in the heating plant. To make matters worse, the cold walls and room furnishings absorb heat from the occupants of the room as well as from the room air. It is then necessary to hold a higher than normal room temperature to obtain the same feeling of warmth on the part of the people in the room. With a higher than normal air temperature the infiltration loss will be increased.

If now the heating plant was not designed for efficient operation at the higher (warming up) heating rate, it will take proportionately more fuel for the amount of heat put into the building. This inefficiency could arise because of too small a boiler or poor combustion. In the case of automatic oil heating, the cut-in and cut-out, of pressurestat or aquastat while thermostat is calling for heat is a source of considerable inefficiency. In this case the main trouble is caused by air being sucked through the combustion space while the burner is off. This cools both the combustion space and the boiler while the heated air is lost up the chimney.

Mr. Parker's complaint of a cracked radiator and end rooms getting no heat at all seems to indicate a steam heating system with poor drainage operating without a vacuum pump. Poor drainage would permit a water hammer which would crack a radiator. Without a vacuum to suck steam through the supply lines and water out of the returns, efficient operation of a heating system is a real problem. In the writer's opinion, the only practical way of controlling temperature on a pressure gravity system covering an extensive area is to open windows of rooms which are too hot. No one ever shuts off a radiator and then opens the valve again before he gets too cold, so hand control is out. It is conceivable that an orifice system could be worked out and balanced to distribute steam evenly to all radiators at timed intervals.

"Wear a sweater and help win the war."

THIRD PRIZE AWARD

Prescott R. Nichols
Reading, Mass.

THERE ARE so many different conditions that it is very difficult to arrive at a conclusion that will fit all cases, or even any case. To begin with, we all know that heat lost equals a constant, depending on wall materials, insulation, glass area, etc., multiplied by the difference in temperature between the inside and the outside. If this was the only factor, reducing the temperature at all times from 70 deg. to 65 deg. would save an appreciable amount of fuel.

There are, however, many other factors. Will the boiler operate as efficiently under a light load as under a full load? This depends upon conditions, but probably it will not and some of the theoretical saving is lost.

The writer is operating a 250-hp., h.r.t. 150-lb. boiler at 15 lb. to furnish heat for three radiators in a power station and four blower type heaters in a combined garage and stock room about 180 by 70 ft. The coal used is about 100 t. per heating season and is hand fired. Three-fifths of the grate area has been removed and a new bridge wall built. With this inefficient arrangement it is possible to see a difference in the amount of coal burned when the outside temperature is zero or below and when it is 40 deg. above. Differences of 10 to 20 deg. disappear before they reach the coal pile. In the case of an arrangement like this the saving by reducing the temperature 5 deg. could not be found.

If the boiler plant supplies steam for power purposes and exhaust steam is used for heating, there would be very little gained by reducing the temperature. On the other hand, if a large part of the boiler load is steam for cooking or heating water or so-called process steam for manufacturing

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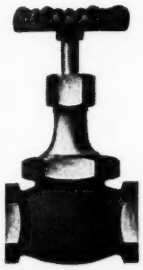

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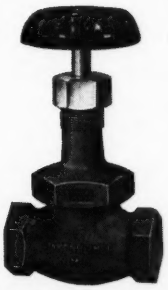

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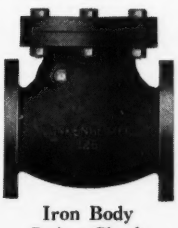

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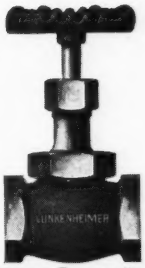

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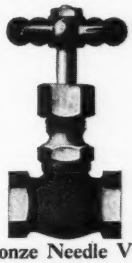

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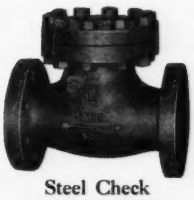

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purposes, there should be a real saving, although it may be hard to find it if the heating load is a small part of the total, since a slight increase in the process steam would use up the saving. If a full equipment of flow meters were available, the reduced steam heating load should be noticed over a length of time. But no two seasons are alike and the results might be surprising.

If the heating boiler or furnace is of the intermittent, oil-fired type or if the burners can be controlled or part shut off at times, some saving should appear in the amount of oil used. But, again, the furnace walls will be cooler and the oil will not burn as well and steam used for auxiliary pumps, blowers, etc., will be a greater part of the total load with a loss of efficiency.

In regard to reducing the temperature at night and restoring it in the morning, we have to consider all the above points and in addition some others such as construction and length of time the temperature is reduced.

If the walls are poorly constructed, if there are numerous air leaks, if there are no storm windows or in other words, if there is normally a large loss of heat, reducing the temperature will effect a saving. The inside and outside temperatures will be closer and the heat needed to heat up the walls, air and contents of the room in the morning will not equal the heat that would have been lost if the temperature had been maintained at 70 deg. all night.

This can be illustrated by assuming that we have a room with a couple of open windows and a heating system large enough to keep the temperature up to 70 deg. We are heating the room all right, but we are also heating all out of doors, or trying to. If we shut the heat off entirely, the inside temperature quickly drops to that of the outside and we save all heat during the time that it is off. When it is turned on, we have such an excess over that which would be needed if the windows were closed, that the room soon comes up to normal again and we again begin to heat up the adjoining country. A poorly-constructed building held at a reduced temperature is a similar proposition but the savings would be much less.

Now let us take the opposite conditions; tight, well-insulated walls, no air leaks and tight storm sash. In this case practically all the heat loss is by conduction through the walls. If the inside temperature is reduced the walls gradually cool to a certain point where conditions become constant and a slight saving occurs, since the outside and inside are more nearly alike. When the temperature is to be raised in the morning, the walls and contents must be heated up which will probably use up most of the heat saved during the reduced period.

This in a way is similar to the experience of a friend of mine who has a 30-gal. electric storage water heater. This is excellently insulated and the radiation loss is about one kw-hr. per 24 hr. This man thought he could save about one-half this loss by shutting off the power 12 hr. during the night, and was much surprised to find that there was practically no saving. He forgot that the hot water would lose heat all during the night, even with the power off (of course at a slightly lower rate as the temperature dropped) and that he would have to put the same amount back in the morning.

With reference to Mr. Parker's freezing radiators, it would seem that there must be something wrong with his system if a reduction of 50 deg. in some rooms will cause freezing in others. Some sort of a throttling control should be put on the nearer radiators, so that with the lower steam pressure or slower hot water circulation or reduced water temperature, as the case may be, all radiators will receive a proportional amount of heat.

Summing up these remarks, there are so many variables that no definite answer can be given, which is just where we came in. Incidentally, one manufacturer of domestic oil burners sent me results of tests made by some organization and a saving of 5 to 6 per cent was made by reducing the temperature to around 60 deg. during the night. No information was given to conditions or how test was made.

DUPLICATE THIRD PRIZE AWARD

J. M. Hartman
Kewanee, Ill.

THE GOVERNMENT ruling for maintaining inside temperatures of 65 deg. or less for the purpose of reducing fuel consumption for heating is based upon sound principles, which are borne out in practice. While it may appear, superficially, that little fuel is saved through such a reduction in temperature, an analysis of the situation will prove rather startling.

Fuel consumption varies directly with the number of degree-days and an indication of the amount of fuel saved may be obtained by the reduction in degree-days due to a lower inside temperature. It is generally known that the degree-day, based on the difference between the inside temperature and mean outside temperature. is a gage of fuel requirements for heating. The degree-day is a figure which is the product of one day, times the number of degrees the average mean temperature outside is below 65 deg. F.

Using the locality of Chicago, Ill., as an example, the degree-days for a normal heating season on a 65-deg. basis, which is satisfactory for 70 deg. inside temperature, are 6315, while the degree-days on a 55 degree-day basis, for 60 deg. inside temperature, are only 3743. This would indicate that a reduction of 10 deg. in inside temperature would reduce the total degree-days about 40 per cent and it would, therefore, result in approximately 40 per cent less fuel. Similar savings would be realized in other localities where the normal degree-days are higher or lower than those for Chicago.

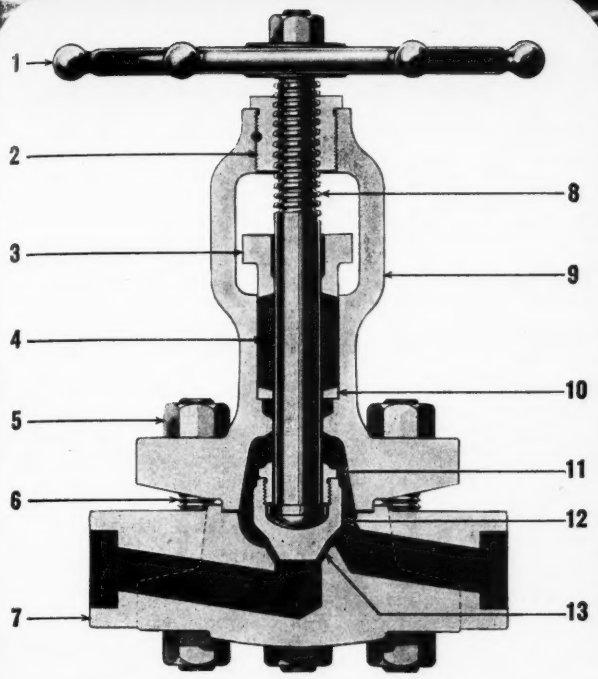
Considered from a practical standpoint, it is realized that the amount of fuel consumed will vary approximately with the difference between the inside temperature and the mean outside temperature. The average outside temperature in Chicago during the entire heating season is about 38 deg. It is considered that the inside temperature in most residences is carried from 73 to 75 deg. Taking 74 deg. as an average, if the inside temperature is reduced to 65 deg. from 74 deg., the mean temperature difference for the season will be reduced from 36 to 27 deg. or 25 per cent, and the corresponding reduction in fuel requirements on this basis will be about 25 per cent.

The amount of fuel saved by lowering the temperature at night has always been a debatable question, but without doubt some saving can be expected, the amount depending entirely upon local conditions such as type of building, number of hours of reduced temperature, and the mean temperature difference. Naturally, the mean temperature difference between inside and outside is lessened by lowering the temperature at night, consequently a reduction in fuel will be realized.

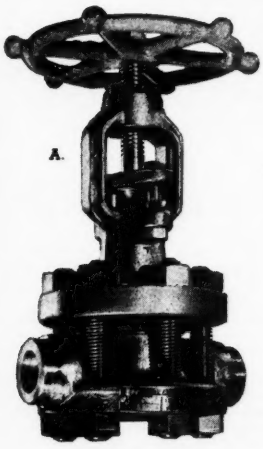
Even though it may seem that much heat is required to bring the temperature back to normal again, it must be admitted that there is a long cooling-down period when no heat is required. It has been determined in the Research Home at the University of Illinois that by setting the thermostat to 66 deg. at 10 P.M. and restoring it to 72 deg. at 5:30 A.M., a saving of approximately 10 per cent is effected in the seasonal fuel consumption.

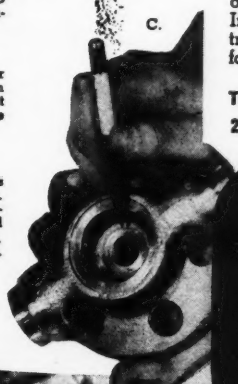
The statement "a temperature of 65 deg. or less means that the end rooms get no heat at all" would indicate faulty distribution of steam in the system. It should be realized that a heating system that has been properly installed and maintained will provide a proportionate share of steam to all radiators regardless of outside or inside temperature. It would, therefore, be advisable to check the system to make sure that the air is being properly vented and the condensate returned to the boiler.

If the heating plant is a one-pipe steam system it may be necessary to provide new air valves. With either a one-pipe or two-pipe system the piping should be checked for suitable drip or bleeder connections and for proper pitch of mains. In this connection, it is highly essential that the boiler water be clean and free from excessive impurities in order to avoid priming and flooding of the mains with water. Draining and thorough flushing of all interior surfaces of the boiler with clear water will usually insure a clean boiler. Faulty distribution of steam may be caused by any number of conditions of design or operation, and it would be necessary to have more information before making specific recommendation for its correction.



13 UNIQUE DESIGN FEATURES *Cut Operating Interruptions* LENGTHEN USEFUL VALVE LIFE





1. Handwheel—malleable iron, oversize and knobbed for easy operation.
2. Yoke bushing—cast bronze, replaceable. Extra length threading minimizes wear, prevents galling.
3. Gland—drop forged steel, through bolted, accurately guided.
4. Packing—braided asbestos, wire inserted jacket with plastic core.
5. Bonnet nuts—easily accessible ASA heavy nuts.
6. Bonnet studs—fully threaded, air cooled, equal length for evenly-stressed tight bonnet joint.
7. Body—forged carbon-molybdenum steel (cast for 2 in. Fig. 5264). Metal distribution equalized to make distortion in heating and cooling negligible.
8. Stem—heat treated and ground EValloy (stainless steel).
9. Bonnet—carbon-molybdenum steel. Deep stuffing box and cooling chamber prolong packing life.
10. Junk ring—hardened, accurately gaged and fitted.
11. Disk nut—finely finished heat treated stainless steel. Pressure tight joint permits leakproof backseating.
12. Disk—alloy steel with heavy layer of ground and lapped Stellite on wide contact face. Balanced symmetry and correct clearances prevent wear in service.
13. Seat—continuous ring of Stellite, integral with body. Perfect alignment with working parts.

A. Ready for hard work. Edward Intex globe stop valve Fig. 2264, socket ends, for 1500 lb, 950 F service. Note simple, sturdy construction.

B. No special tools needed for disassembly. Screw driver in slotted stem square makes it easy to assemble or remove stem and disk assembly.

C. Wear-resisting Stellite seat is part of body in Intex valves. This means greater protection against corrosion and erosion, fewer interruptions, less maintenance, longer life.

EXTRA PROTECTION against costly operating interruptions, easier maintenance, extra life, and greater fitness for tough service are built into Edward Intex* valves in 13 different ways.

From the integral Stellite seat, which forever eliminates the possibility of leakage between the seat and body under high operating temperatures, to the easy-to-operate handwheel, every one of the 13 principal parts of Edward Intex valves have been designed for maximum operating efficiency under severe service conditions.

Like the integral seat, the contact face of the perfectly proportioned disk is generously faced with erosion-resisting Stellite. Valve ports are designed to give the least possible resistance to flow consistent with quick, positive cut-off.

Maintenance, though seldom necessary, is unusually simple. No special tools are needed for disassembly, and working parts are easily accessible.

Available in socket welding, screwed or flanged ends from ½ to 2 in., Intex valves are rated at 1500 lb sp at 950 F, but are equally trouble-free and economical in intermediate service.

*Reg. U.S. Patent Office.

Bulletin No. 12-G5 describes in detail the advantages of the smaller size Edward Intex valves. Full dimensional data, illustrations and material specifications. Write for your copy today!

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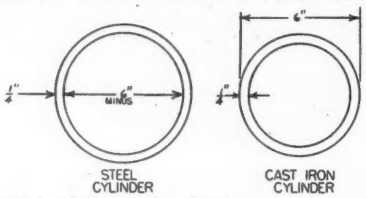
EDWARD *Steel* CAST AND FORGED VALVES

Questions And Answers

Question No. 218

Shrinking a Steel Cylinder Onto a C.I. Cylinder

WOULD YOU kindly tell me the proper inside diameter of steel cylinder or outside diameter of cast-iron cylinder, both as shown in the sketch, so that when one is shrunk onto the other the elastic limit of either material is not exceeded?



Steel cylinder to be shrunk onto cast iron cylinder

I prefer the case where the steel cylinder is shrunk onto the cast-iron cylinder. Perhaps you could give me a formula. What temperature would be necessary for this operation?

Bronxville, N. Y. S. S.

Question No. 219

How Much Oomph Does This Float Have?

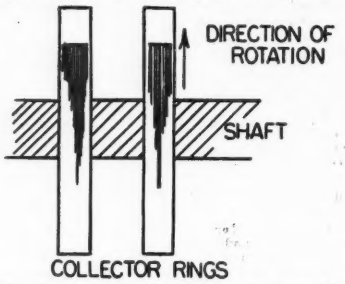
I DO NOT have the problem of the two vats, but want to install a float-controlled valve something like that shown in Rollin Lager's solution of the two-vat problem in the January issue. Now, if I have a float of exactly 1 cu. ft. volume, weighing 5 lb., how much force will it make available to operate the valve, under the three conditions shown: A, floating; B, just submerged; C, at X ft. below the water surface. If the float is just submerged, will F_1 be 62.4 lb.? But what will F_1 and F_2 be if the float is in positions A or C? I understand that the pressure increases 0.434 psi for every foot below the surface. With a 2 to 1 leverage F_2 will always be double F_1, of course. What will be the upward force F_3 on the fulcrum under the various conditions?

Bronxville, N. Y. S. S.

Question No. 220

What Makes the Marks On the Collector Rings?

IN THE POWER station where I am a shift operator, we have two 2000-kw. and three 3000-kw., 2300-v., 60-cycle, separately-excited a.c. generators, steam turbine driven at 3600 r.p.m. These machines are operated in parallel and connected to a common bus system.



Why these smears on the collector rings after shutting down?

Every time we take a generator out of service, we find when the rotor comes to rest that we have a long, discolored smear that reaches about one-third the way around the nice, shiny collector rings—one smear for each brush on each ring. The smear starts off exactly the shape and size of the brush and then drags out to an uneven, ragged end, as shown in the sketch. It looks exactly like an arc and apparently happens when the oil circuit breaker is opened.

We never open our field excitation until the machine comes to rest; also the generator is completely unloaded, according to our watt-hour meter disc, before the oil circuit breaker is opened.

I will appreciate any information you can give as to the cause of these smears.

Texas City, Tex. O. V. D.

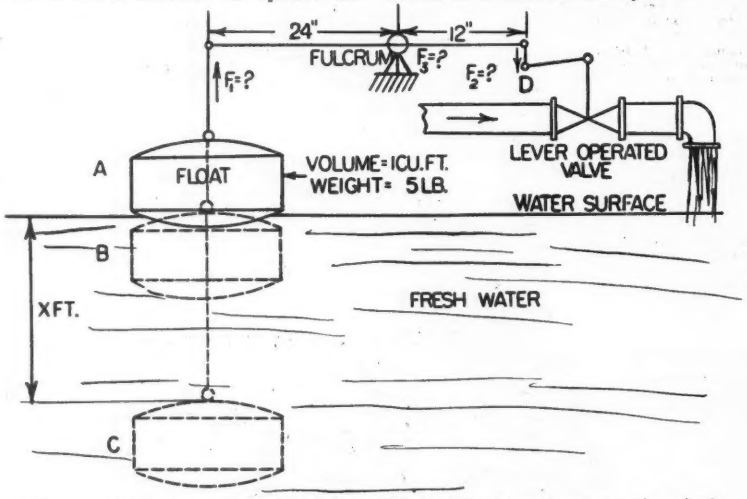


Diagram of a float-operated valve hook-up. What are the forces to operate the valve?

Answer 183

Drying Air by Refrigeration

WAR CONDITIONS have made caustic potash scarce and A. A. E. who has a liquid oxygen plant in Mexico asked on p. 100 of the June issue whether it was practical to dry air by refrigeration in order to save on the use of potash.

A Snappy Answer From Falstaff Brew

THIS QUESTION is not brief enough for me. There are several ways of drying air for different uses. One is for air conditioning which is produced by a fan; another is for storing in a tank produced by air-cooled compressor; and another produced by water-cooled compressor which is stored in a tank which is used for spray guns, air hammers, drills, etc.

New Orleans, La. GEORGE DEICHMANN
Falstaff Brew Plant No. 4

Answer 193

Locating Leaks in Buried Vacuum Lines

HERE IS a probable way for I.D. to find the leaks in his buried vacuum line. As described on p. 96 of the October issue this line, buried 2 to 3 ft. below a 5-in. concrete floor had developed a number of leaks. I.D.'s problem was to locate these leaks without having to tear up 200 ft. of concrete floor.

You Can Do It with Gas

IN ANSWER to Question No. 193, I believe that if the vacuum line were blanked, and a pressure put in it of gas fumes, and a device that the gas companies used to find leaks in their gas lines under street pavements was used he should be able to locate the leaks easily.

Newark, N. J. RICHARD CHARLES CONK

Answer 203

This Engine Pulls Water Out of the Boiler

EVERYBODY agrees that there's something wrong with the valves of E.H.'s Unaflow engine, a 16 by 15-in., 257 r.p.m. unit that "pulls water out of the boiler"

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CRANE VALVES

when load is put on. E.H., you recall, says that when he tries to start up, the crank end won't take steam and has no compression, but the head end has terrific compression. William Rixman offers one interesting explanation of this. The concensus seems to be that the valves are not correctly set, or somep'n. Also that the engine is too big for the boiler and for the 60-kw. alternator it drives.

The various comments on engine operation are published in such great detail because nowadays engineers are being called on to make every conceivable type of obsolete and standby equipment, especially old engines, generate power. So the more they know about them the better, for the plant management expects them to take anything with a shaft in it and make it turn the war production wheels.

Overhaul, With Special Attention to Valves

IF THE ENGINE "pulls water out of the boiler" what pulls the engine? An engine of these cylinder dimensions, at 257 r.p.m., will certainly create a very heavy demand on the boiler unless the engine is in good condition.

If the writer's figures are correct, there's only one reason in the world why a 100-hp. boiler cannot maintain steam for a 60-kw. unit: poor mechanical condition of the engine or wrong valve setting.

The engine does not really pull water out of the boiler, but it is in such very poor condition that the steam flows through the unit, doing very little work. This creates a demand on the boiler so great that violent priming takes place, with the result that the water level in the boiler falls rapidly, giving the impression of "pulling" water out. When the pressure is being rapidly reduced from the surface of the water directly under the boiler stop valve, this water at high temperature immediately tends to flash into steam and is carried along the main steam line to the engine with undesirable results.

The remedy for this situation is a thorough overhaul of the engine.

Special attention should be given to the valve settings so that, instead of steam flowing practically idle through the cylinder, it shall be made to do work on the piston and show a normal expansion line on the indicator cards. These should be taken and adjustments made until desired results are obtained.

Having a 'terrific' compression on the head end and none on the crank end clearly implies that the valves or valve setting is badly out of order. Have the engine opened up and checked for mechanical condition of the rings, cylinder, valves, etc. Check the valve setting for the various points of admission, cut-off, etc., and check the cylinder clearance.

These operations should be performed only by an experienced engineer who is familiar with the maintenance of this kind of equipment.

After these have been corrected as nearly as possible, put the engine in service at various loads and take indicator cards, which will give a true picture of the internal performance of the unit. Adjustments can be made accordingly.

If the governor is put in good shape, it will not be necessary to have an auxiliary set of exhaust valves, as this will be automatically controlled by the steam demand.

I believe that in this case the steam lines should be fitted with a steam flow meter, with which one could determine clearly how much steam the units are consuming. The cost of such a meter would be very soon repaid with big dividends in fuel saving. a matter which is an imperative duty of a good engineer at all times and in this emergency is doubly important.

Kearny, N. J. GEO. MCNALLY

Was Crank End Valve Closed off? asks Rixman

The alternator driven by this engine is rated at 60-kw., approximately 80 hp. This 16 by 15 engine, at 257 r.p.m. and 100 lb. gage, is capable of about 200 i.hp. Hence it is much too large for a 60-kw. alternator and evidently was tried out single-acting, with crank end steam valve closed off and cylinder drain always open.

There is a certain type of Unaflow engine made for condensing operation only, and this type has a relief valve at each end of the cylinder to increase the clearance volume to help relieve compression. It is not practical to operate non-condensing. Auxiliary exhaust valves are required for non-condensing operation of this engine.

As for water to the engine, proper pitch of pipe, a steam separator and efficient trap should eliminate this.

This 100-hp. boiler at rating, is capable of 3400 lb. of steam per hour. A 200-hp. Unaflow requires about 5000 lb. of steam per hour. Here would be a possible cause for drawing some water to engine at full load, if the engine were developing 200 hp.

E.H. might try adjusting both steam valves for proper admission, look at the cylinder drains to see that they close tight and back off on both relief valves in the heads. This will still give too high compression for practical operation, but the engine should turn over and you will note the effect when you close the cylinder drains.

Cincinnati, O. WM. E. RIXMAN

Engine Clearly Too Big for Boiler, Parks Calculates

BASED ON E.H.'s figures, I believe the engine is too large for the boiler unless the boiler is operated at a high rating and the engine is the only load, which is not probable. If we assume that the operating pressure is 150 psi., the boiler operated at 150 per cent rating, the engine cutting off at ¼ stroke, the size is 16 by 16 in., then the cylinder volume is 3216.96 cu. in.

As the engine cuts off at ¼ stroke and takes steam at both ends or twice each r.p.m., then the volume becomes 1608.48, disregarding the piston rod; 1608.48 divided by 1728 and multiplied by the speed of the engine gives us a volume of 239. per min. or 14,340.60 cu. ft. per hr.

According to the steam tables, steam at 150 lb. gage is 2.753 cu. ft. per lb., then the steam consumption of the engine is 5209 lb. per hr. If the boiler is operated at 150 lb. rating, the nominal output would be about 5200 lb. per hr.

However, if the engine pulls water from the boiler when load is applied, this may be remedied by installing a loop rising about 10 ft. above the steam main and dropping down to the engine.

The fact that the engine has high compression at the head end and none at the crank end indicates faulty valve setting and can only be remedied by resetting the valves. As this engine has too high a compression to be operated non-condensing, relief valves of some sort must be provided to relieve some of the compression. I believe that if the engine valves were set properly and some sort of a condenser rigged up, it could be made to work fairly satisfactorily, provided that the boiler can be operated at a rating high enough to take care of the steam demand. The fact that the standard engine runs a 75-kw. generator means little, due to the design of the engine.

Baltimore, Md. CHAS. W. PARKS

Sam Williams, Too, Says Valve Trouble

IN E.H.'S PROBLEM, if we assume that the boiler conditions are normal, one reason for the engine causing priming is evident from the fact that the valve setting is abnormal. From the statement that the head end shows terrific compression we gather that the steam valve does not cut off at the proper point, thus causing a surging effect upon the boiler by creating too long and excessive a period of steam flow, and by leaving too much steam in the cylinder after exhaust.

The make of engine is not given, hence valve setting instruction cannot be set forth here.

Let E.H. examine the engine and determine if the relief valves he mentions do not open into an auxiliary chamber in the cylinder head. If so, the engine can probably be operated non-condensing, with these relief valves open.

If these valves are of the mechanically or vacuum operated type, it is obvious that what E.H. needs is the services of an experienced valve setter. At any rate, let him proceed cautiously, lest he find himself in the market for a new cylinder head and connecting rod.

SAM WILLIAMS

Answer 208

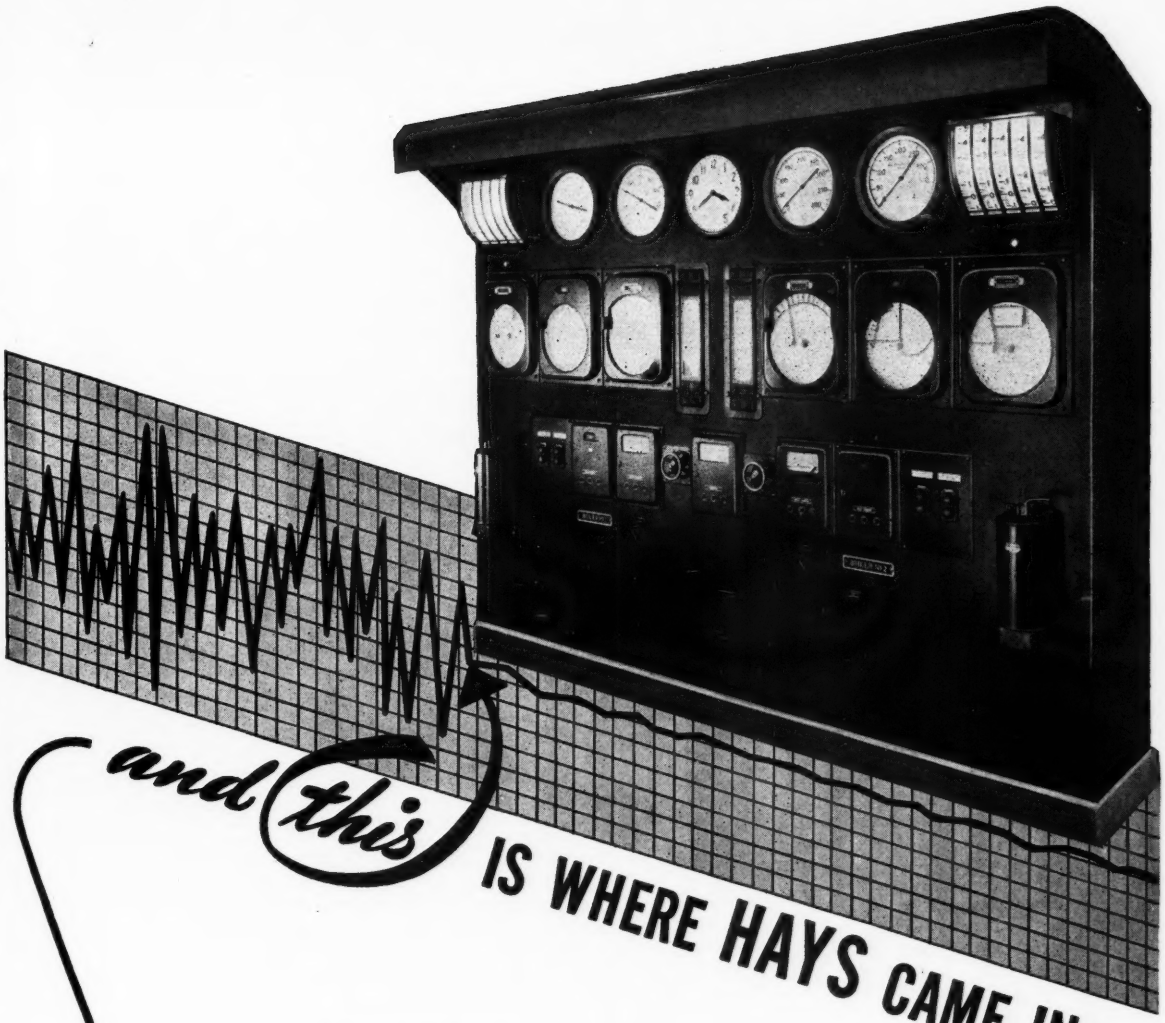
Removing Sludge from Refrigerating System

IN THE December, 1942 issue, F. Mcl. mentioned having trouble with the formation of sludge in his refrigerating system, he wanted to know the cause of this and how it could be removed.

C. T. Baker says you've got to give attention to the oil itself and to the methods of handling it, and Edmund J. Bonnett tells how oil gets into the system and forms sludge and gives details of a method he has used for removing it.

Use Proper Oil, Proper Drainage and Cleaning

THE FIRST thing to determine is the nature of the sludge which will indicate its cause. Most likely it is a mixture of oil and dirt, pipe scale, etc.



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Two things are necessary to prevent sludge. First, use only a good grade of mineral oil having a vapor point above the normal discharge temperature and a congealing point below the evaporator temperatures.

Second, see that oil drains are provided on all evaporators, whether coil type, brine coolers or unit coolers. See that oil is drained at stated intervals from all evaporators, as well as from the high-pressure traps on the discharge lines.

If the wrong oil is used, trouble will occur, even though no sludge is formed. It is entirely possible that before F. McI. can completely cure his troubles, a complete blowing out of the system with compressed air may be necessary.

Atlanta, Ga. C. T. BAKER

How Bonnett Got His System Clean

RECENTLY in our plant a beer cooler failed to function properly, due to sludge in the ammonia pipes. Upon calling the engineers who installed this beer cooler, we were advised to do the following:

(1) Pump a vacuum on the cooler.

(2) Pour 2 gal. of kerosene into the ammonia pipes of the cooler.

(3) Allow this to remain in the system two days while using the cooler as usual.

(4) Pump the suction or low side of the cooler down to 5 lb. pressure.

(5) Blow the contents of the cooler into the sewer (using plenty of water to dilute ammonia as it goes into the sewer).

As this cooler is connected with the entire refrigeration system of our plant, we therefore purged our oil traps daily for several weeks to remove any sludge or oil which was pumped back by the compressors. Also we had to clean out several screens or strainers in the suction lines ahead of the main suction valve of the compressors.

Possibly this may help you eliminate your trouble. The only way sludge can form in an ammonia system is due to faulty rings in the compressor that allow oil to be pumped into the system.

If anyone else comes forward with a solution to remove sludge from a system I would appreciate your advising me as to how it may be done.

Terre Haute, Ind. EDMUND J. BONNETT

Capital Costs Are Real

By CORNELIUS G. WEBER

RECENTLY, I noticed two articles, in POWER PLANT ENGINEERING by outside contributors and, because the data contained therein seem incomplete, I hope that either the authors of those two articles or others may supply answers to clarify what appears to be ambiguous.

It hardly requires mention that isolated industrial power plants frequently are more economical than public utility service or that in many other instances the reverse is true. There may also be instances in which municipally owned central stations can effect savings over public utility power supplied from privately owned plants.

However, by inference at least, the two articles to which I shall refer presently, appear to attempt to show the outstandingly economical performance of two certain power plants and; while they no doubt reveal correctly the out-of-pocket operating costs, they are incomplete, in my estimation. The final figures of unit costs, or costs of energy per kilowatt-hour, which they disclose would not be the criterion for judging the economy of these plants.

I refer first to p. 77 of the February, 1942 issue of POWER PLANT ENGINEERING to an article relating to a new municipal plant at Provo, Utah. This article, unless read with considerable care, may create the impression that purchased power costing more than 7.42 mills per kilowatt-hour would not be competitive with power produced by the municipal plant. By leaving out the cost of capital that is a charge for interest on the investment, the author of the article has given only a part of the total cost.

The cost of the plant has been given as $723,238.68 and, apparently does not even include indirect construction costs which are a real part of the total cost. However, even excluding such indirect construction costs and assuming an annual interest charge of 5 per cent on the stated figure of $723,238.68, there will be added an amount of $36,161.93 to the cost of generating energy for the year given. Applied to 12,115,850 kw-hr. output this represents 0.298 cent per kw-hr. Added to 7.42 mills, the total cost would be 1.04 cents per kw-hr. By eliminating the cost of stand-by service, the cost becomes 1.013 cents per kw-hr.

If taxes formerly paid to Provo by the utility and, which the city is now losing—and they are an indirect part in a comparison of costs—the real cost, upon the basis of the published statistics, would be even higher than 1.013 cents per kw-hr.

Moody's Manual of "Public Utilities" shows the following statistics for the Utah Light & Power Co.:

1939	*Kw-Hr. Sold*	*Amount*
Industrial Power	536,897,000	$4,247,054
1939		
Commercial Power	60,919,000	2,313,281

Unfortunately the 1940 and 1941 statistics group industrial and commercial power so that the industrial power cannot be isolated, for those 2 yr. Assuming that power rates have not been increased and that Provo could buy at a rate at least as favorable as the average of industrial power rates, it would seem that such rates would have been slightly under 8 mills per kw-hr., as indicated by the 1939 figures for industrial power, or $4,247,054 divided by 536,897,000 kw-hr. equals 7.9 mills per kw-hr., approximately. This is materially less than the article referred to when adjusted for capital costs.

The question I raise in regard to the Provo plant is: In what respect is it economical, assuming that the City of Provo had acquired the distribution system, then purchased power from the local utility, and redistributed it at retail to consumers?

I wish to refer next to an article on p. 62 of the August, 1942 issue of POWER PLANT ENGINEERING. In this connection I am not disputing that the Diesel engine plant discussed may not be generating energy for less than the cost of purchased electricity, as this depends upon the service rates in the specific instance. However, when the writer of that article leaves the less careful readers with the thought that the costs are only 7.4 mills per kw-hr., by disregarding a charge against capital and, that the new plant he refers to will be paid for in 5 yr., I cannot help but take issue.

It seems reasonably certain that a plant such as is described in the article must cost at least $21,000. If fixed charges were estimated at 12 per cent, this part of the cost, when applied to 147,860 kw-hr. generated, by itself, would represent substantially 1.7 cent per kw-hr. or more than twice as much as the direct costs cited by the author of the article. Adding 1.7 cents to 0.74 cent results in almost 2.5 cents per kw-hr.

This latter figure may or may not be an entirely correct figure but, I believe, it would be nearer the true cost than 7.4 mills.

The question I have in regard to the foregoing is: What is the approximate real cost per kilowatt hour in the plant cited? Possibly the author of the original article or others familiar with the specific or similar plants can supply an answer through these columns and thus help clarify this and similar matters.

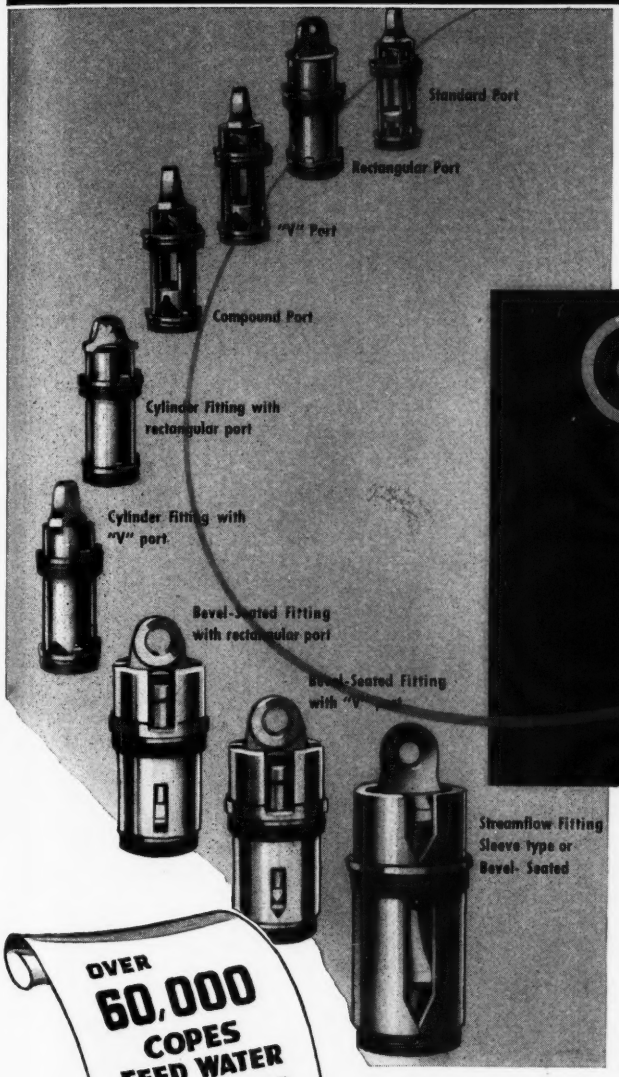
In the calculation and recording of unit operating costs, engineers have several purposes. One is a day-to-day comparison in order to indicate trends. Another is to use this cost to compare efficiencies with other plants of like or similar design. The out-of-pocket operating costs, as Mr. Weber terms them, are helpful for certain purposes but in using them in making comparisons the engineer must be certain how they have been obtained, what has been included and what left out.

Total costs, upon which rates to be charged for services must be based, must include every item of expense entering into that service. If consideration is given only to the operating expenses for which the engineer in charge is responsible, the resulting cost figure will be much lower than the real cost based upon total expenses of the plant.

Mr. Weber raises a question which should never be overlooked when calculating actual costs for use in comparison between different plants. There are, however, very definite and valuable comparisons within the plant itself that can be made through the use of operating costs only and a discussion of how operating costs and total costs compare in addition to direct answers to Mr. Weber's questions should prove helpful. —Editor.

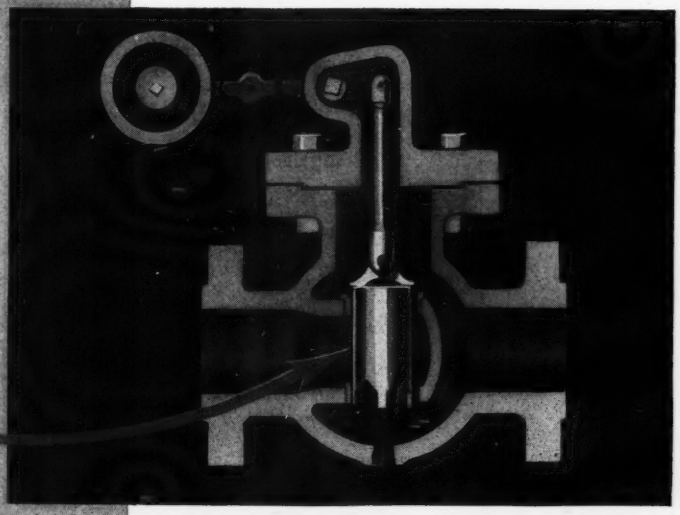
NO TWO BOILERS ALIKE

THAT'S WHY THE COPES BI-VALVE IS DESIGNED FOR THE BOILER IT SERVES



THE BI-Valve is as common to COPES Feed Water Regulation as is the familiar Thermostat. With 30 years of constant improvement and simplification, checked in over 60,000 applications, the BI-Valve is built to meet all boiler feed water requirements.

Out of several hundred exhaustive tests with as many different types of inner valves, we have learned which size of ports are necessary to give the proper imput to your boilers. They are tailored to meet specific operating conditions.



These "made to order" inner valves are one of the reasons for superior COPES performance—the closest relation between water imput and steam output—smoother charts.

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FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

CAPACITY CHART FOR HORIZONTAL CYLINDRICAL FUEL OIL TANKS

Standard 275 gallon Oval Tank.	
Inches Oil Level	0
1	9 gal.
2	18
3	28
4	38
5	48
6	59
8	81
10	104
12	128
14	154
16	178
18	202
20	224
22	245
24	265
26	285
28	*
30	*
32	*
34	*
36	*
38	*
39	*
40	*
41	*
42	*

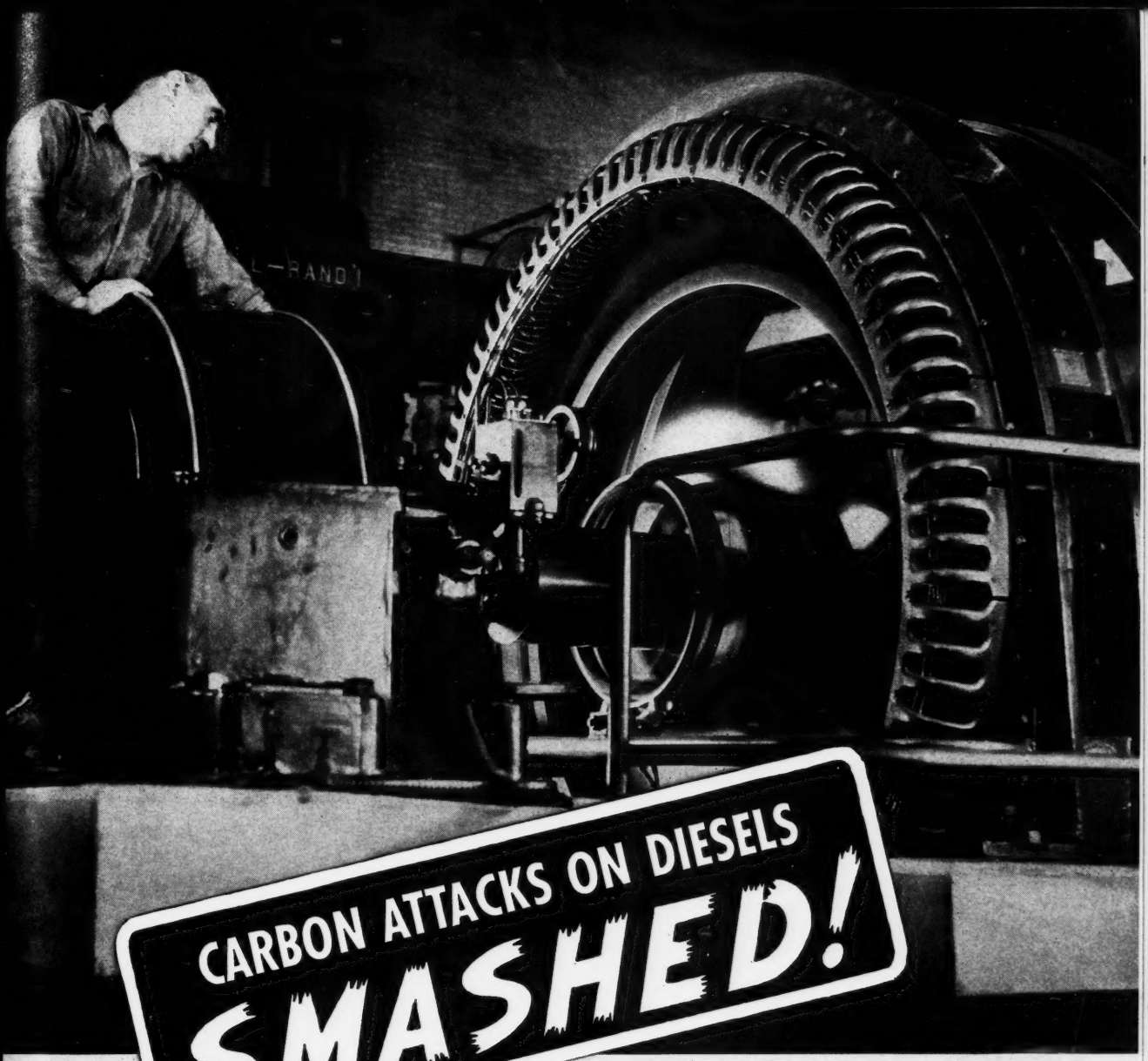
Note: Do not include neck when measuring diameter

1. For standard 275 gallon oval tanks, read directly from table at left.

2. For cylindrical tanks, measure length of tank or ascertain total capacity; measure diameter of tank and depth of oil (through a plugged opening or gauge connection) on measuring stick and use charts above.

3. Example: Tank 48" diameter, 78" long, 20" of oil. From 48" diameter on Scale A, travel horizontally to the right to point of intersection with diagonal line representing 78" tank length and then drop vertically to read capacity of 600 gallons on Scale B.

   Knowing tank capacity, read left from 48" diameter on Scale A to intersection with 20" oil depth line and drop vertically to Scale C which shows that tank is 40% full. Continue vertically down to intersection with 600 gallon capacity line, then travel horizontally right, and read gallons in tank on Scale D — in this example, approximately 240 gallons.



CARBON ATTACKS ON DIESELS SMASHED!

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For 10 years the generator-connected diesels in a large plant manufacturing electrical controls were plagued with carbon. Numerous high-grade lubricants were tried—all resulting in the same trouble. Carbon accumulated to such a point that forced shutdowns occurred on an average of once every 60 to 90 days, causing serious trouble and power losses.

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PUMPS and PACKINGS —They Need Attention

Satisfactory operation of pumps requires the upkeep of all parts of the unit itself and regular care of packing joints where leaks are likely to occur. Directions for making pump inspections and the care and use of packings are given here to aid wartime maintenance

By FRED D. MOSHER

AS THE WAR progresses, the list of critical materials will be extended and many high grade steels and alloys will become scarcer with time. Power plant operators are affected by almost every restriction, and each new curtailment must be cause for redoubled efforts in plant maintenance. There are many opportunities for intensive work in the maintenance of most plants, and one of them lies in the upkeep of pumps.

If a pump is designed properly for the service intended and installed in accordance with good practice, the actual troubles in operation may be few. But pumps wear out, and in some cases the wearing out process may be rapid; it is the objective of good pump maintenance to delay or slow up the wearing out process. Sound, organized maintenance will go far in accomplishing this objective. Pump maintenance is concerned with the upkeep of the pump itself and the regular care of the pump packings; when either one is neglected results cannot be satisfactory.

Common Pump Troubles

Most pump troubles have the effect of lowering efficiency, and consequently capacity of the unit, which, when prevalent throughout a plant will materially reduce total plant capacity. In power plant operation pumping operations are, for the most part, confined to handling water at normal or moderately high temperatures, pumping oil at moderate pressures and temperatures, and the distribution of chemicals for feedwater conditioning. Water pressures depend on the operating pressures of the boiler equipment.

Wearing out comes from lack of proper lubrication, solids in suspension carried through the pump, scoring of rods induced by poor packing jobs, bad alinement resulting from worn rods, and chemical action on pump parts and packings. Too tight packings, for example, will cause overheating, scoring, and abnormal wear. Leakage of high temperature, chemically treated water, may cause a concentration of chemicals as flashing occurs at the point of leakage, chiefly around stuffing boxes and rods.

Changes to adjacent and connecting piping often put strains on pumps causing misalinement. Neglected packings, packings which have outlived their usefulness, and packings misapplied, may have destructive effects on pumps. It is the purpose of good maintenance to prevent trouble from developing by taking the necessary corrective steps in advance.

Pump Inspection

Operators should be charged with the daily inspection of pumps under their care. Lubricators should be kept filled, feeding the right quantities of lubricant, and adjusted to supply adequate lubrication. Unusual sounds should be noted since they often herald the approach of trouble inside the pump. Gages installed in suction and discharge lines may tell a story, and the condition of valves, the presence of air, and loss of volume will be indicated by the pressures shown.

Drop in discharge pressure will be caused by air pockets in suction line, worn packings resulting in leakage, damage impeller, wearing rings worn, leaking suction line, plugged water seal, and partial plugging. Loss of head and capacity, pounding of valves and pistons, and starting difficulties should be reasons for investigation. Grease cups should be kept filled and operating, and hand oiling, where required, should be done regularly.

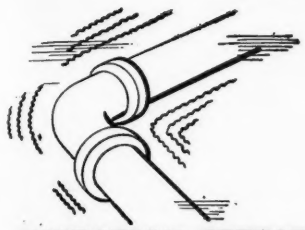
The maintenance department should make monthly inspections of all pumps in operation. At the monthly inspection packing glands should be checked and seals ought to be examined. It should be noted that sealing fluids and water-cooled bearings are receiving adequate liquid.

Packing leakage should be kept at the minimum required and the maintenance department should know that the packing in question is in condition to allow gland adjustment. Where pressure gages are not provided connections for attaching temporary gages should be provided. Checks with gages, listening rods, and observation should present a story as to the condition of each pump at the time of the monthly inspection.

A yearly inspection of each pump by the maintenance department should involve the overhaul of each unit and a thorough inspection of the internal parts, with particular attention being given to moving parts, and the surfaces affected by them. The preponderance of trouble with centrifugal pumps comes from wearing and erosion of impellers, wearing plates, and shafts. Regardless of condition of the packings, good practice dictates that packings be renewed each year except in the case of pumps in severe service which should have packings renewed each six months.

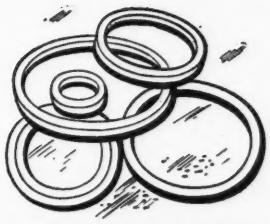
The condition of valves and seats should be noted each year and cleaning up and grinding should be done at that time. Examination of internal surfaces for corrosion is a part of the annual overhaul and where such action is found it is often possible to take corrective measures before actual damage is done. Any replacements necessary should be done when the pump is down for overhaul. Bearings must be examined and all old packings should be examined for the story they will tell regarding the condition of the pump.

Experience has shown that all packings have a definite economic life and the fact that trouble does not develop within a year does not mean that the packing should be continued in service. Chemical action, drying out, and ordinary wear and tear make



VIBRATION EFFECTS

You need never worry about vibration or strain loosening a *welded* joint.

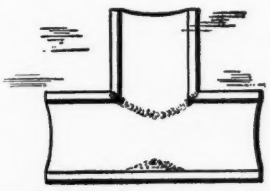


GASKET CHANGES

Fewer flanged joints mean less gaskets—save materials and time.

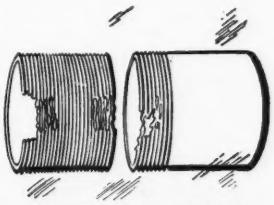
How to eliminate these piping troubles that hamper war work:

Weld with TUBE-TURN WELDING FITTINGS



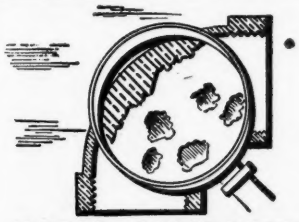
SLAG ACCUMULATION

Butt welds with Tube-Turn fittings virtually eliminate danger of slag.



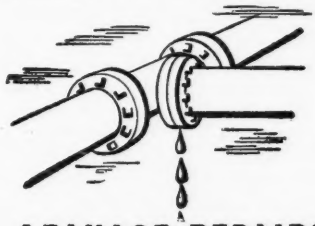
WORN THREADS

Threading thins and weakens metal—causes failures.



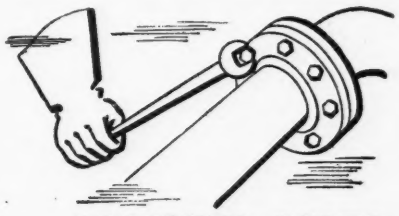
RAPID CORROSION

Tube-Turn fittings resist corrosion because of better metal structure.



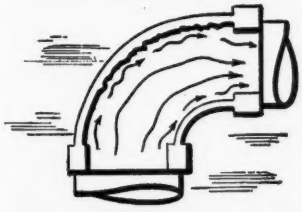
LEAKAGE REPAIRS

No chance of loose connections or leaks with Tube-Turn fittings.



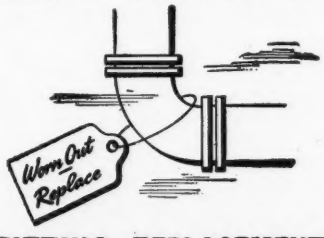
LOOSENED BOLTS

The more welding fittings used, the fewer bolts there are to tighten.



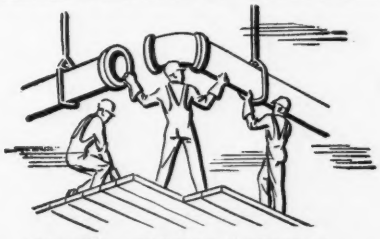
INEFFICIENT FLOW

Easy sweeping radius and no offsets inside mean less pressure loss.



FITTING REPLACEMENT

There's far less time loss or replacement expense with Tube-Turn welding fittings.



SLOW INSTALLATION

Tube-Turn fittings line up perfectly; allow fast, simple, easy butt welding.

NO. 3 OF A SERIES

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most packings disintegrate rapidly once the wearing out process begins.

To continue packings in service beyond the normal life of the material is to risk troubles which may rapidly mount and require costly repairs. Packings which have outlived their usefulness lose the ability to seal against leakage, and the dried out condition of the material may work havoc on rods and shafts when repeated gland tightening is practiced.

The sample pump inspection check list shown may be used as an aid to pump inspection and maintenance. An inspector using such a list would call attention to specific defects by checking items requiring attention or making notations recommending repairs. The card or sheet would be completed by the person making repairs and returned to the file as part of the pump record. Such records could be used for summarizing annual costs, spare parts requirements, and other essential information.

Packings for Maintenance

The first requisite for good packing maintenance lies in the selection of the packings themselves. The packing should be of both the proper quality and proper size for each job. Although many packings may serve for many different jobs, there are no universal packings available. In selecting the quality of packings, consideration must be given to the nature of the pump, service conditions, and the pressure and temperature of fluids being handled.

To compensate for the shortage of rubber and rubber compositions as many substitutions as possible should be made. There are many of these available. For example, moulded rings consisting of duck and rubber for outside packed pumps and many triplex pumps may be adequately replaced with bonded asbestos packings impregnated with lubricant; the asbestos materials may also be used for high temperature work for which the rubber composition packings are not suitable.

Plated asbestos packings with surface graphiting are suitable for both reciprocating rods and rotating shafts of pumps handling hot oils and high temperature water. Where alkalies or acids are likely to shorten the life of ordinary packings, blue asbestos fiber ropes are used providing they are impregnated with special lubricant. In revising a packing chart it is wise to accept the recommendations of the pump manufacturer and the packing supplier. Such revisions may be necessary to take care of rubber and metal shortages.

Packings should be stored in a cool dry place with each type of packing kept in its individual container. The packings themselves must be clean and wrapped for protection. Identification tags ought to be clearly marked as to type, size, and service for which the packing is to be used. Hands should be clean when handling packings and cutting and fitting should be done in clean surroundings.

PUMP NO.	CONDITION		WORK REQUIRED	WORK COMPLETED
	GOOD	DEFECTS		
STEAM END				
WATER END				
DISCHARGE				
SUCTION				
PACKINGS				
DRIVE				
LUBRICATION				
SEALS				
PIPING				
FOUNDATION				
PRESSURES				
OPERATION				

Pump inspection check list

Packing a Pump

When old packing is removed from a pump it must be carefully examined for the story it may tell about the condition of the pump itself. A misalined plunger or rod would have the effect of reducing the packing cross-section directly over or on either side of the rod. If the pump is operating with a low bearing, the cross-section of the packing would be reduced directly underneath the rod.

Missing rings of old packing may mean that they have been forced into the pump by repeated tightening, and is a good indication that the pump needs packing more frequently. A poor packing job done previously would be indicated by the distortion found in the old rings; such a condition might be caused by the use of short rings or undersize packings.

Outside wear on packing rings show that the packing has been moving on the shaft or rod, and would be caused if slightly undersize packings were used. A dry, hard, or glassy inside surface on packing rings, while the outside appears to be in good condition, is always evidence of poor lubrication.

Packing is intended for sealing and cannot take the place of bearings which are supporting devices. Clean out all old packing and remove particles of dirt, metal, and other foreign material before installing the new packing. Use all new, clean packings, and do not add new rings to a previously packed stuffing box. Care should be taken to get clean cuts and exact fit. Clean cuts may be obtained by taping either side of the place to be cut; an improvised mandrel, exactly the size of the rod or shaft, will serve as a means of getting good fit.

Packings should be impregnated with lubricant; flax or tuck packings should be soaked overnight before fitting. Rings should be installed staggered at 90 deg. in a clockwise direction. Rings of packing should be pressed

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home firmly but not rammed into place. After the rings have been inserted the gland should be taken up evenly until tight. If a lantern is used care must be taken to get it properly located where the sealing liquid is not blocked.

After the gland has been tightened to take up the packing rings, it should be backed off and retightened by hand. Normal take-up should be made after the pump has been returned to service, and the take-up should be sufficient only to provide the minimum leakage required for lubricating the rod.

It is difficult to pack a badly worn rod, and the best practice is to machine the worn part to a new diameter and provide new packings to fit. When a rod is only slightly worn, and operations prevent a shutdown for the time required to renew the rod, temporary measures may be taken to keep the pump in service.

It is important that packing of the correct size be used in packing the pistons of piston type pumps. The packing is cut on the job from fibrous materials which usually require soaking in water before fitting. The layers are peeled off the packing strip until the correct thickness is obtained; the joints are made to lap in a snug fit. Not over ⅛ in. clearance should be provided, and the joints must be staggered at the usual 90 deg.

Care of Idle Pumps

It frequently becomes necessary to keep a pump idle for an extended period, especially where the pump is in seasonal service. Idle pumps should be drained and protected from freezing, rusting, and corrosion. If possible, the best practice is to operate the pump at least once a week, and if this is impracticable it should be turned over by hand at weekly intervals.

Heat applied to a drained pump will render the packings useless. The packing glands of idle pumps should be backed off, and where the packing has seen little service it may be used again in service. In general, however, it is best to re-pack a pump which has been idle for an extended period. The internals of idle pumps should be clean. Exposed parts ought to be protected from corrosion and pitting by a light film of grease.

THE IGNITRON

(*Continued from page* 79)

in operation since there are no rotating or moving parts except the small rotary vacuum pump and the centrifugal water-circulating pump. The only other noise is a slight magnetic hum of the excitation circuit and the transformer apparatus. This quiet operation is a real advantage where substations must be maintained in office buildings or residential districts.

Applications

The Ignitron rectifier was introduced by Westinghouse in 1937 and the first installation was made early in that year. In less than 5 yr. over 2,000,000 kw. of Ignitrons have been purchased which shows how industry has accepted this equipment.

In the electrochemical field, where load is maintained continuously at full capacity, the Ignitron rectifiers have undergone their most severe tests. Proof that they can carry heavy loads continuously at high efficiency and with minimum maintenance is found in the increasing number of applications in this field. Fig. 1 shows one-half of a 77,400-kw. 645-v. d.c. rectifier station supplying power for aluminum production.

Although the aluminum industry ranks first among the users of Ignitrons, large installations are supplying power for the production of magnesium, chlorine, and zinc.

Most electrochemical processes require only a few volts at several thousand amperes per electrolytic cell. As the production requirement for the particular material increases, a greater number of cells are connected in series. When the total cell-string voltage reaches 250 v. the application comes within the realm of the Ignitron rectifier. The need for greater quantities of most metals for wartime use is bringing many industries close to the change-over point.

Electric Railway Service

Ignitrons are well suited for electric railway service which is subject to large fluctuations in load and to heavy overload peaks. For highly fluctuating loads, the units contribute to economy of operation by maintaining their high efficiency under the light load conditions. Since momentary overloads or even a short circuit does not damage the rectifier units, they are ideally suited for applications involving high load swings. Figure 3 shows a 3000-kw., 740-v. railway substation.

In addition to high efficiency and higher overload capacity, mining service requires installation in isolated places and low head room. The lightweight and compactness of the Ignitron rectifier in relation to its rating, as well as its complete adaptability to automatic operation, makes it particularly suited for mining service. Figure 6 shows a 300-kw., 275-v. completely automatic portable Ignitron substation for low head coal mine service.

Besides coal mining, Ignitrons are supplying power for a large portion of the country's copper and iron ore mines.

Industrial Applications

Wherever there is need for power conversion in the 240 to 900-v. range, the Ignitron rectifier offers many advantages over rotating conversion equipment. Ignitrons are supplying power to cranes, elevators, welders, variable speed presses and rollers in our large shipbuilding yards and steel mills as well as in many smaller essential industries.

The compactness of the Ignitron in relation to its rating is a decided advantage where space is at a premium. In cases where existing stations are already crowded, rectifiers can be installed on balconies without difficulty.

Ratings

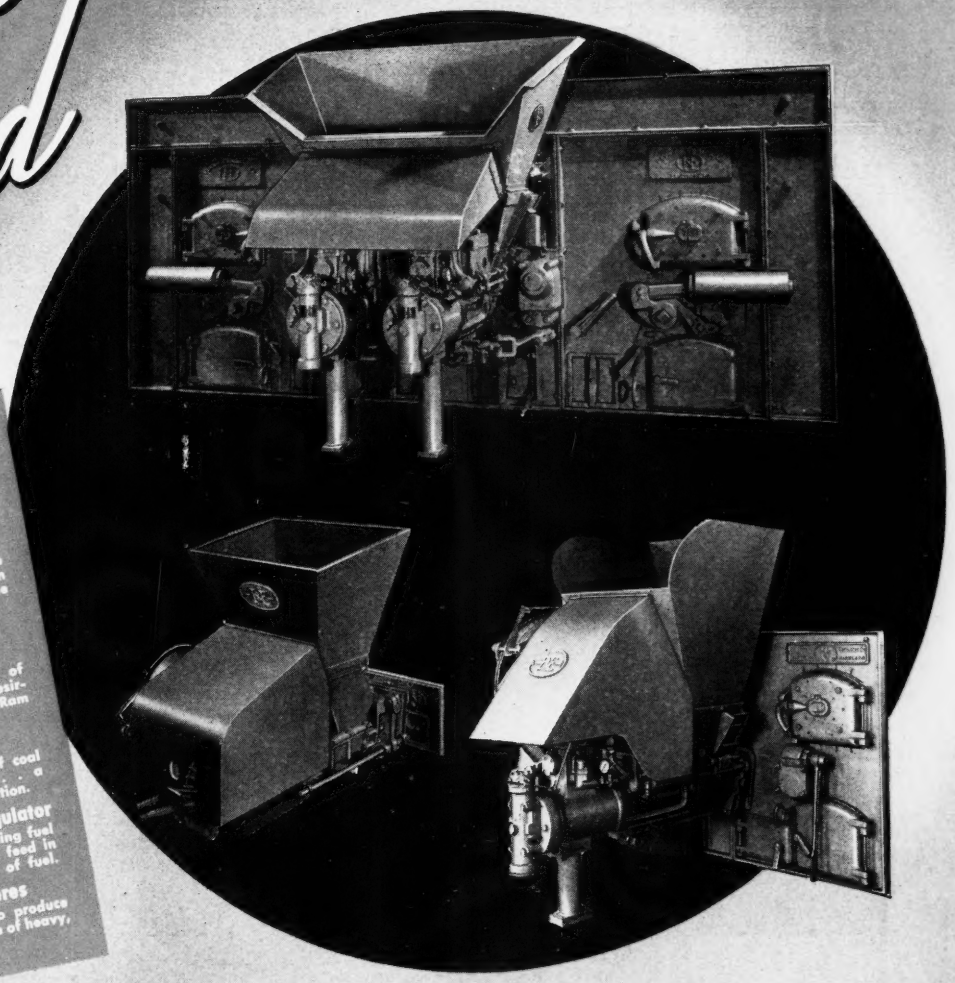
Rectifiers are rated according to the standards which apply in the service for which they are intended. Ignitron rectifier units are available in ratings from 75 kw. at 250-v. d.c. up to 8000 kw. at 900 v. d.c. For higher capacities units are operated in parallel.

In order to transform the available alternating current supply to the proper voltage and number of phases required for the anodes, a rectifier power supply transformer is essential on all installations. The transformer can be designed to suit the power supply that is available.

Rated overloads and high momentary swings have no injurious effects on mercury arc rectifiers. Overloads specified in the ratings are therefore available for regular operation without involving additional maintenance costs. Overload cycles must however, be separated by intervals of full load or less for sufficient time to permit the rectifier and transformer to reach normal temperatures.

On Guard

WHERE BOILER HORSEPOWER MUST NOT FALTER!



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3. **Retort Sliding Bottom** Assures equal distribution of coal over entire boiler area . . . a necessity for efficient operation.
4. **Exterior Fuel Bed Regulator** Permits adjustment of burning fuel bed without reducing coal feed in event of change in grade of fuel.
5. **High Efficiency Tuyeres** Designed by "F & E" to produce perfect combustion. Made of heavy, heat-resisting metal.

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In fifteen years "F & E" Underfeed Stokers have acquired a reputation for dependability that was brought about by the "F & E" policy of producing a line of stokers engineered to make automatic coal burning an asset to power plants.

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Hundreds of "F & E" installations throughout the coal-burning areas of the United States are, today, producing a large share of the horsepower that is turning the wheels of war production and civilian industry . . . furnishing the heat that will preserve the health of the occupants of housing projects, hotels and apartments.

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"F&E" Stokers are 'on the job' successfully burning F&E **the lowest as well as the highest grades of coal**

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BITUMINOUS AND ANTHRACITE TYPES—ELECTRO-HYDRAULIC AND STEAM DRIVE
FOR HEATING OR POWER BOILERS REQUIRING 1,000 TO 40,000 LBS. OF STEAM PER HOUR.

Darts Have these EXTRA WIDE Matched Bronze Seats that help give them extra long life

Let's go back to Dart fundamentals—fundamentals which explain why old Dart Unions can be put back on the job—to work efficiently together with new Darts.

In the first place, let's consider the extra-wide matched bronze seats, ground to true-ball surfaces, that make it possible for a Dart Union to be used so many times . . . with the assurance of tightness each time. Then let's take the High-test Air Refined Malleable Iron Dart nuts and bodies that resist pipe strains, rough handling.

And to get back to fundamentals again: it *always* pays to specify Dart Unions . . . for old or new, a Dart comes through. See your supplier today . . . and keep searching your plant for *old* Darts.

DART UNIONS

E. M. DART MFG. CO.

PROVIDENCE, R. I.

ELECTRICAL ENGINEERS DISCUSS WAR PROBLEMS

(*Continued from page* 84)

of serving consumers with electrical service. Basically, in addition to light and heat the consumer wants his motor to spin and do work. It so happens that this service requires two types of electrical energy. The major type, which is also the real pay load on the system, is known as the "active" or the kilowatt component. It is this component that turns the lathes, grinds the flour, etc. The other type of energy known as the "reactive" or kilovar component is the type that is needed to magnetize transformers and induction motors. This latter type of energy does not cause the disc of a watthour meter to turn but it can use system kw. capacity to generate it and deliver it to the consumer. Until the advent of the present day capacitor, kilovars were largely supplied by kilowatt generators in the power plant but now, such kilovars are more advantageously supplied by a low-priced kilovar generator, i.e., a capacitor.

These matters were interestingly covered in a very excellent paper by J. W. Butler of the General Electric Co. The purpose of Mr. Butler's paper was to determine what portion of the total system investment can equitably be allocated to the system's kilovar requirements. He showed that a value of 2 to 6 per cent of the system investment is chargeable to the kilovar requirements when it is supplied near the load by auxiliary kilovar generators, as contrasted to 20 to 25 per cent when supplied by kilowatt generators in the power plant for systems operating around 80 per cent power factor.

Power Recovery from Testing Aircraft Engines

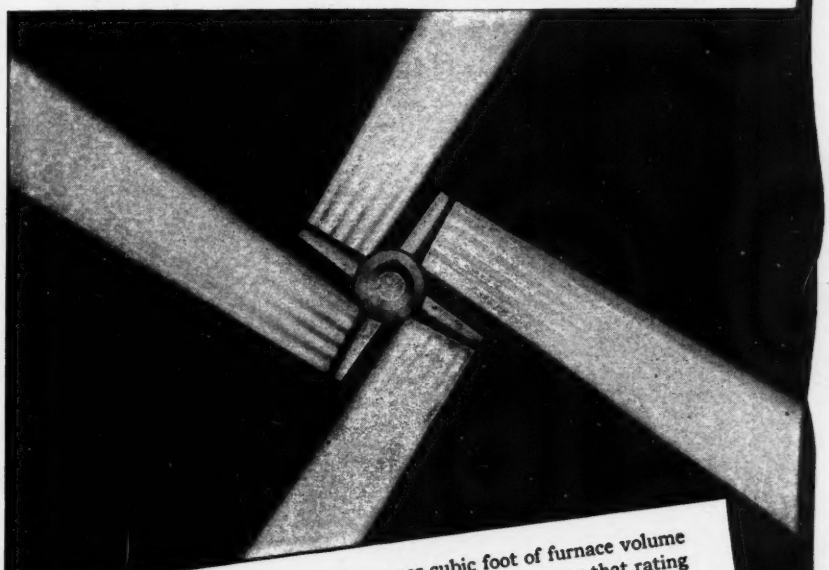
At a session on industrial power applications Cassidy, Mostiller and Wright, all of G.E., presented a rather interesting paper on power recovery systems for testing aircraft engines. As was pointed out by one of the authors in the presentation of this paper, since three to four times as much capacity in aircraft engines is built in this country every year as is installed in all the central stations of this country, power recovery systems are on the whole well worth while.

HOW TO INCREASE THRU-PUT BY ONE SIMPLE CHANGE

Pinwheel Action STEPS UP RATINGS

Installing Coppus-Dennis FANMIX Gas Burners permits increased heat release per cubic foot of furnace volume

"Pinwheel Action" combines gas with air in a properly proportioned mixture. Gas escaping from orifices in the blades, rotates the fan, causing in-take of air at right angles to path of gas. The energy in gas under pressure is utilized to perform work by mechanically mixing and proportioning the gas with just the proper amount of air, thus eliminating from the furnace the necessity of serving as a mixing chamber as well as combustion space.



You get so much more heat release per cubic foot of furnace volume when you change to Coppus-Dennis FANMIX Gas Burner that rating of boilers (or other equipment) can be increased far beyond the limit allowed by present burners.

New Principle in Gas Burners Gives EXTRA Values on Top of GREATER HEAT RELEASE

Even Temperature: complete combustion without impingement—no drifting "hot spots". *No Cracking of Wet Gas:* driver arms stay below "cracking" temperature. *On New Installations:* smaller combustion space, less stack required, no forced draft equipment needed. Write for free Booklet 410-3 which explains *other* savings you make with Coppus-Dennis FANMIX Gas Burner — a Coppus "Blue Ribbon" Product. Address: Coppus Engineering Corporation, 333 Park Avenue, Worcester, Massachusetts.

You'll get valuable ideas from these free bulletins on other Coppus Blue Ribbon Products

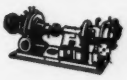
(Check the ones you want)

☐ Coppus Unit Air Filters. For industrial ventilating and air conditioning systems. Bulletin F-320-5.

☐ Coppus Heat Killers. Keep production up by keeping men cool. No stale air recirculation. Air is directed. Bulletin 160-5.

☐ Coppus Cable Manhole and Tank Ventilators. For confined working spaces. Bulletin 163-1.

☐ Coppus Boiler Manhole Blowers and Exhausters. For cooling boilers, drums, etc. Bulletin 161-3.



☐ Coppus Steam Turbines. 6 sizes (and prices) from 150 H. P. down to fractional. Bulletin 135-9.

☐ Coppus-Dennis Fanmix Gas Burner (described in this ad).

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Company.....

Address.....

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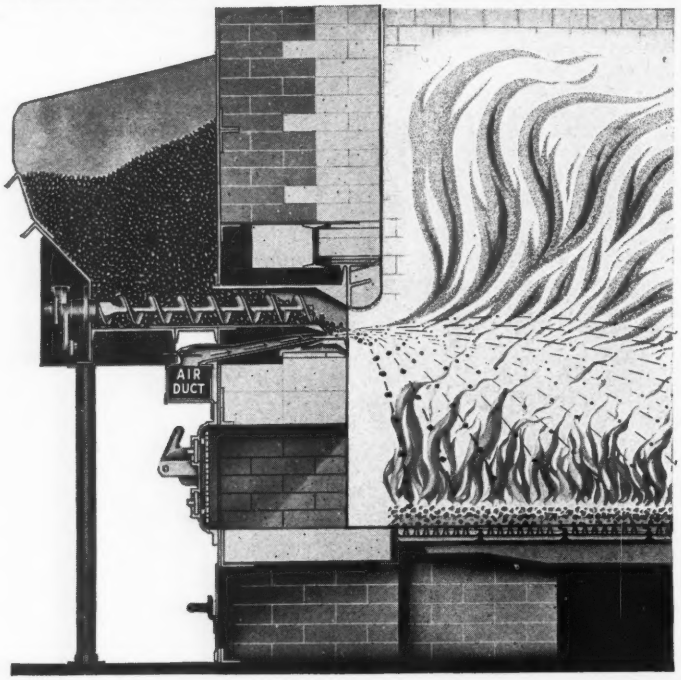
Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEETS' CATALOG.

COPPUS

COPPUS BLUE RIBBON PRODUCTS DESIGNED FOR YOUR INDUSTRY . . . ENGINEERED FOR YOU

FYR-FEEDER

MULTIPLE SPREADER STOKERS



MEET *EVERY* WARTIME FIRING NEED!

BURN COAL LIKE OIL—FYR-FEEDERS burn fines in suspension; spread coal over entire fuel bed, burning larger pieces on grate.

USE ANY COAL—Local coals, cheap coals, screenings or sweepings—all burned efficiently with a FYR-FEEDER.

SAVE LABOR—Firing is less work with a FYR-FEEDER and anyone can operate it—experienced men not essential.

INCREASE BOILER CAPACITY—Many users report one boiler can do work of two with a FYR-FEEDER.

SAVE MONEY —Helps meet higher costs and taxes.

For Quick Conversion from Oil to Coal

These and many other advantages accrue to users of FYR-FEEDER Multiple Spreader Stokers. The FYR-FEEDER method of firing is *ideal* at *any* time, it is rapidly becoming the *only* method to solve *all* the requirements of wartime.

WRITE FOR NEW CATALOG TODAY!

AMERICAN COAL BURNER COMPANY

FOUNDED 1918

Builders of thousands of industrial stokers

22-18 E. Erie St. **Chicago, Illinois**

As pointed out in this paper aircraft engines must be tested and broken in by operation under load for considerable periods of time before they are shipped. Several techniques are in vogue for accomplishing this testing, none of which utilize the power output of the engines in test except a recently adopted electrical system. The paper described the development of this system and the part it is playing in the testing of the large aircraft engines being built today. The development of the power recovery system of testing aircraft engines was started in the fall of 1937. Today such systems recover as much as 58 per cent of the power developed by the engines on test.

This excellent paper did not go without criticism. Mr. Mahoney of the Wright Aeronautical Corporation, who was present, it appeared was more or less fundamentally opposed to the use of such systems. He conceded that for certain types of manufacturing plants—those building essentially one type of engine, they had their merits, but in general he seemed to feel that they were not all they were imputed to be. Incidentally, he mentioned the fact that the Wright organization had expanded 20 times in 4 yr.

Education

Possibly the most interesting sessions held at this meeting were those on education on Wednesday. The first of these constituted the General Sessions at 10:00 o'clock Wednesday morning. At this session President Harold Osborne of the Institute presented the Alfred Nobel Prize to George W. Dunlop. This presentation which was brief was followed immediately by three addresses, the first by a Col. Paterson. The reason for Col. Paterson's place on this program is not quite clear since the subject of his discussion, a forceful plea against the institution of a forced savings plan for U. S. citizens, had little or nothing in common with the meeting in general.

His address, however, was followed by two very excellent discussions on the general theme "Technical Man Power in the War Effort," the first, by Col. Bukema of the War Department, and the second by Dr. Joseph W. Barker, formerly of Columbia University but now special assistant to the Secretary of the Navy.

Both of these addresses were extremely interesting. They described in considerable detail the

Tube cleaning takes -a new turn

-with the new

ELLIOTT

1300 Series

TUBE CLEANERS

"Tube Cleaner Headquarters" has done it again—stepped up the tempo and the power of cleaning equipment with new developments of far reaching significance. These are particularly aimed at facilitating the cleaning of short radius curves and bends of modern boilers.

1 **The new ELLIOTT HINGE COUPLING**

2 **The new ELLIOTT more powerful motor**

3 **The strong ELLIOTT cutter head universal joint**

The new Elliott hinge coupling takes all the stiffness out of the connection of hose and motor. It is notably strong, assembled "for keeps," and slips easily to the angle required by the tube turn. The new Elliott 1300 Series motor is handier, more powerful, and its design includes a lubrication system which insures a new standard of generous lubrication for *all* bearings — front as well as rear. Means longer service, of course — and also less maintenance, and the transmitting of *more* power to the cutter head.

Check on these major developments. Write us.

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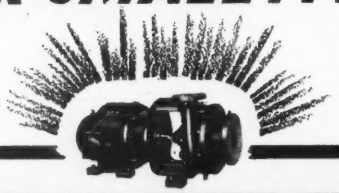
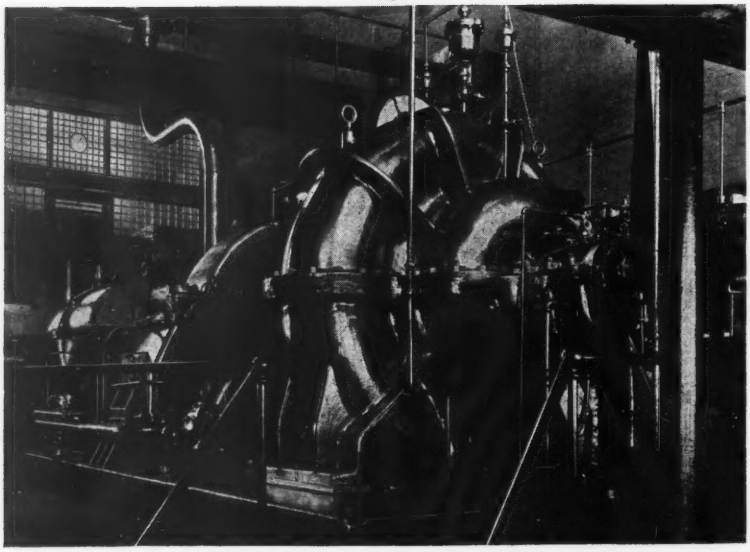
ELLIOTT COMPANY

Tube Cleaner Department
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

For LARGE Capacities OR SMALL . . .





WARREN PUMPS

are Built To Fit the Job

Whether a pumping job calls for *tremendous* capacities or small ones, you can count on Warren Pumps to give dependable, long and low-cost performance. *Every* Warren Pump is built to fit the job . . . with *no compromising* with sound engineering principles.

All Warren Pumps have good details. They have liberal clearances that insure highest practical efficiencies and low power costs, year after year. They have extra heavy shafts that minimize internal wear . . . over-size bearings . . . broad-faced case rings . . . properly proportioned liquid passages.

Investigate Warren features for yourself . . . both in Centrifugal and Reciprocating types . . . if you want pumps that can do more than their share.

WARREN STEAM PUMP COMPANY, INCORPORATED

Warren, Massachusetts

plans of the Army and Navy for the training of technical men in the schools and colleges of this country. Beginning in March and April, the Army and Navy will take over a large portion of the engineering schools of the country. By means of an elaborate system of screening tests, young men will be withdrawn from all branches of the armed services and placed in college. It is an extremely democratic plan whereby for the first time in the history of this nation, intellectually capable boys will be given the opportunity of attending college regardless of their individual financial condition. They will be in the Army or Navy and will have $50 a month to spend in addition to their board and clothing.

The extent of this training program can only be fully realized when it is compared to the normal educational activities of the country. Normally, the engineering colleges of the country have been turning out around 12,000 graduates a year. Under the planned Army and Navy system, next year 150,000 men will be withdrawn from the armed services to go into college. Also, some 70,000 aviation cadets will be distributed throughout the country and attached to various schools. In addition to this, short courses will be given to about 60,000.

The educational opportunities of the Army and Navy will be open to all men. Screening boards are to be established whose function it will be to determine which men are eligible. Any man who has had 9 wk. of his 13 wk. of basic training can take the screening tests. There will be both fixed and travelling screening boards.

The courses given will be essentially technical but will be under the supervision of the regular college faculties. Students will work; there will be no social life, no extra-curricular activities. They will spend 5½ days a week in classes and will have from Saturday noon until Sunday evening supper, off.

In general, the courses will include, engineering, medicine, psychology and foreign area studies. Of particular interest, as explained by Col. Bukema, is a course in American History, different from the usual courses in history offered by colleges. This course will be designed to show that the ideas of freedom and democracy did not begin on July 4, 1776—that the

We waited 4 Years to make this *Announcement*

★ ★ ★

EARLY IN 1938, Shell Scientists and engineers, after long tedious months of experimenting, were ready to give a new turbine oil its supreme test. Exhaustive laboratory analyses had shown it possessed properties previously thought unattainable by even the most optimistic turbine manufacturers.

But Shell men were not satisfied. "How will this new turbine oil stand up under actual operating conditions?" was the question they wanted answered.

There was but one way to find out . . . test it in turbines. They did. After a 2-year run, samples taken showed every characteristic of the original oil. Further checking was done . . . other tests were made. It still looked "as good as new."

Then, and only then, was the new Shell Turbo Oil announced. That was in January 1941. Even then many operators were doubtful that Shell Turbo Oil was as good as we claimed. "It hasn't been in use long enough," they said.

Today Shell Turbo Oil is able to show a performance record that should convince the most skeptical. For after more than 30,000 hours of operation in a power company's turbine, Shell Turbo Oil tests as well as the day it was put in over 4 years ago. To the original filling of 4,400 gallons only 300 gallons of make-up oil have been added. Certified chemical analyses of samples taken from the turbine show no signs of deterioration on any score.

30,000 hours of operation, in itself, is no record for a turbine oil. But 30,000 hours *without a single sign of structural breakdown* is a record in which every turbine operator should be interested. It is but one of scores of records being set by the new Shell Turbo Oil in all types of turbines.

Here is proof positive that the new Shell Turbo Oil has *the two most important* characteristics necessary to the proper lubrication of modern turbines:

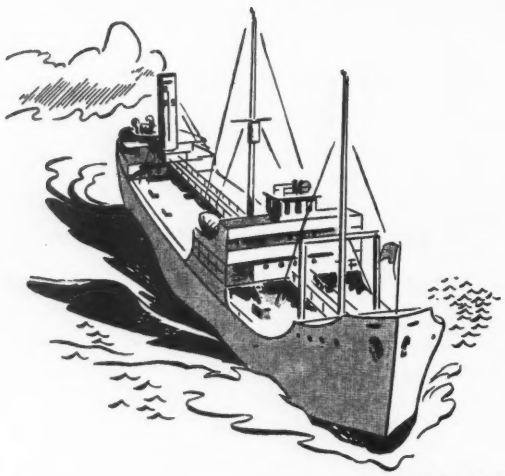
SUPERIOR OXIDATION STABILITY
RUST PREVENTION

Ask the Shell man for the details today!

(Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil.)

Shell Turbo Oil

SHELL

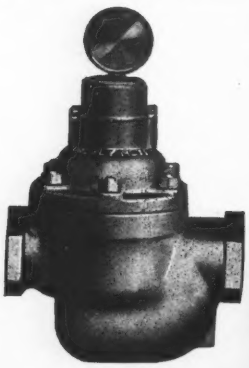


MEASURING THE "Life Blood" OF OUR MECHANIZED ARMY

Endlessly our tankers ply across the seven seas—braving storms and submarines to bring to our mechanized forces the oil and gasoline so vitally necessary for their continued operation.

Henszey Boiler Feed Water Meters are riding the waves on many of these tankers—to be there to accurately measure the precious liquid at the end of the long haul. They do this tough job exceedingly well. Yes, do it well, because they were designed with a minimum of working parts without close clearances. They are particularly fitted for this new job.

This tough assignment is only one of the many jobs performed by Henszey Meters in war industries. Applications include the measuring of boiler feed water, hot, dirty blowdown, condensate, free running chemicals and many other liquids that cannot be satisfactorily measured by ordinary meters. They are equally accurate at high or low flow—high or low pressures—on duplex, triplex or centrifugal pumps. Sizes range from 10 g.p.m. to 1200 g.p.m., cold water, steady flow rating. Pipe connections ¾" to 6", special sizes to order. Calibrations can be made to read in gallons, pounds, or cubic feet at any specified temperature. The meter is easily installed right in the line.



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HENSZEY
BOILER FEED WATER
METERS

HENSZEY BLOWDOWN SYSTEMS

Boiler Feed Regulators • Flow Indicators
Proportioning Valves • Heat Exchangers

roots of democracy lie not in America but in Europe.

There will also be a pretty heavy course in global geography. The reason for both of these courses, the one in history and the one in geography, is to equip our soldiers for service in foreign countries after the war. It will be necessary to keep men in foreign countries, probably, for many years after the war ends and these courses will give them a better background for working and cooperating with the people of the countries in which they may be stationed.

Both Army and Navy programs are much alike. As Dr. Barker indicated, the problems of the Navy, even more than the Army are entirely technical and as a consequence every effort will be made in the Navy program to develop the technical skills of the students.

The presentation of the comprehensive educational programs, materially created great interest among the members. Few could say anything against the plans, but a number of men put in a plea for the needs of industry. Industry, it was pointed out will also need technical men and if the Army and Navy is going to take the entire supply of new technical graduates, the war effort will suffer.

Mr. McCutcheon, of the Reliance Electric Co., presented a very sensible and very sincere discussion of the program Wednesday afternoon, at the wartime education conference. As he explained, it is not a question of what the Army needs or what the Navy needs or what industry needs; rather it is a question of what the Army and Navy needs of industry in order that the latter may supply the Army and Navy with what they need. There was little agreement between the representatives of the armed services and of industry in this respect and in the end, it is quite probable that industry will have to get along as best it can. Good or bad for the war effort as a whole, the Army and Navy will take all they can get.

Getting More Out of Equipment

As already mentioned, a large number of papers presented at the meeting were devoted to methods of getting more use out of existing equipment during wartime. At the electronic conference, on Wednesday afternoon, various methods were presented for extending the life of tubes. Among other things of interest brought out at this ses-

YOU CAN BANK ON FAIRBANKS

for Bronze Globe, Angle and Cross Valves

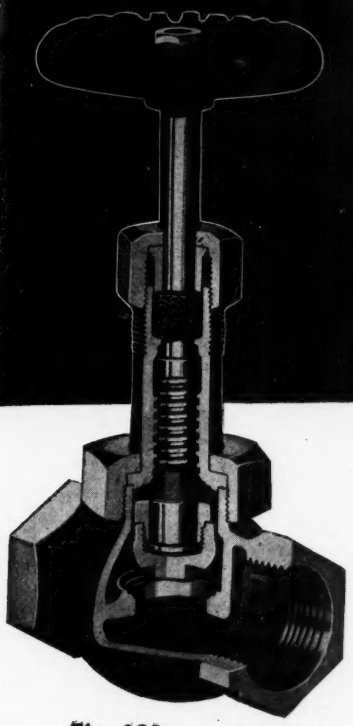


Fig. 029

TIME-TESTED AND SERVICE PROVED

SERVICE: Recommended for applications on steam, water, oil, gas and air. Available for steam working pressures from 125 to 350 lbs.

TYPES: Fairbanks Valves are made with Bronze, Nickel Alloy and Renewable Composition Discs in Plug and Regrinding types. with Union, Screwed-in and Bolted Bonnet.

FEATURES: The valves illustrated have a bronze seat and disc which can be reground if they become worn, without removing the valve from the pipe line. They can be easily dismantled and re-assembled because of the union bonnet. Stem has full-cut Acme threads. Stuffing box is deep and valves can be repacked under pressure when wide open. All parts are interchangeable, except stem.

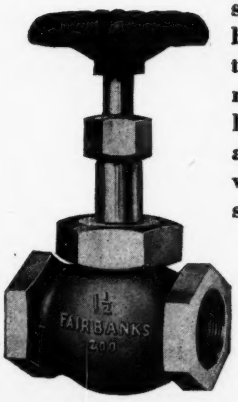


Fig. 029

Fig. 031

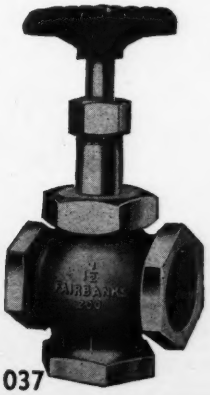
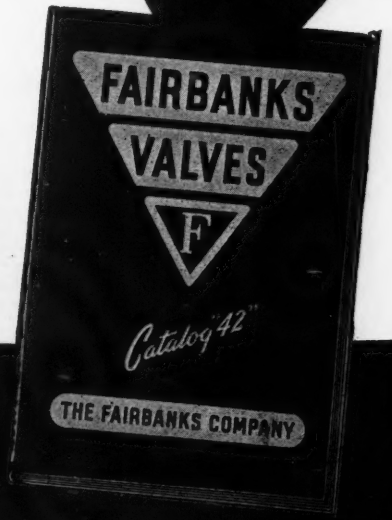


Fig. 037

OTHER FAIRBANKS VALVES

Bronze Globe, Gate, Angle Cross and Check Valves
Iron Globe, Gate, Angle, Cross and Check Valves
Faircoseal Bronze Valves
U-Bolt Gate Valves
Asbestos Packed Cocks
Bronze Radiator Valves
Sphero Ball Valves

CONSULT FAIRBANKS NEW CATALOG No. 42 FOR DETAILS



THE FAIRBANKS COMPANY

393 LAFAYETTE ST., NEW YORK, N. Y.
BOSTON, MASS. PITTSBURGH, PA.

Distributors in Principal Cities

BALDWIN-HILL
BLACK ROCK-WOOL INSULATIONS

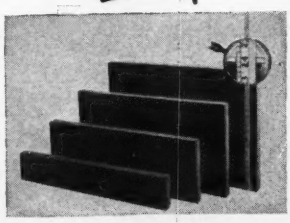
MOISTURE does not disintegrate this utterly different form of rock wool. It does not make it settle. It can't ruin its insulating value. By actual test, B-H black rock-wool absorbs less than 1% of its weight in moisture after being immersed completely.

That is one reason for specifying B-H black rock-wool. Another—equally important—is its stability under heat and vibration. 1400° of flame, which cut their way right through ordinary white rock-wools, leave B-H unharmed. Remember these facts and investigate B-H black rock-wools, felts, blocks and cements.

B-H

FREE TO POWER-PLANT MEN

A generous sample square of Baldwin-Hill Mono-Block, the one block for all temperatures up to 1600°, together with a sample of B-H Bond-Tite, the easy adhesive which makes wiring unnecessary. Test for yourself the heat-resistance, the extraordinarily low conductivity, the quick adhesion, and ease of cutting of this universal insulation. Just write us on your letterhead.



BALDWIN-HILL *Insulations*

577 KLAGG AVE. TRENTON, N. J.

NEW YORK CHICAGO KALAMAZOO

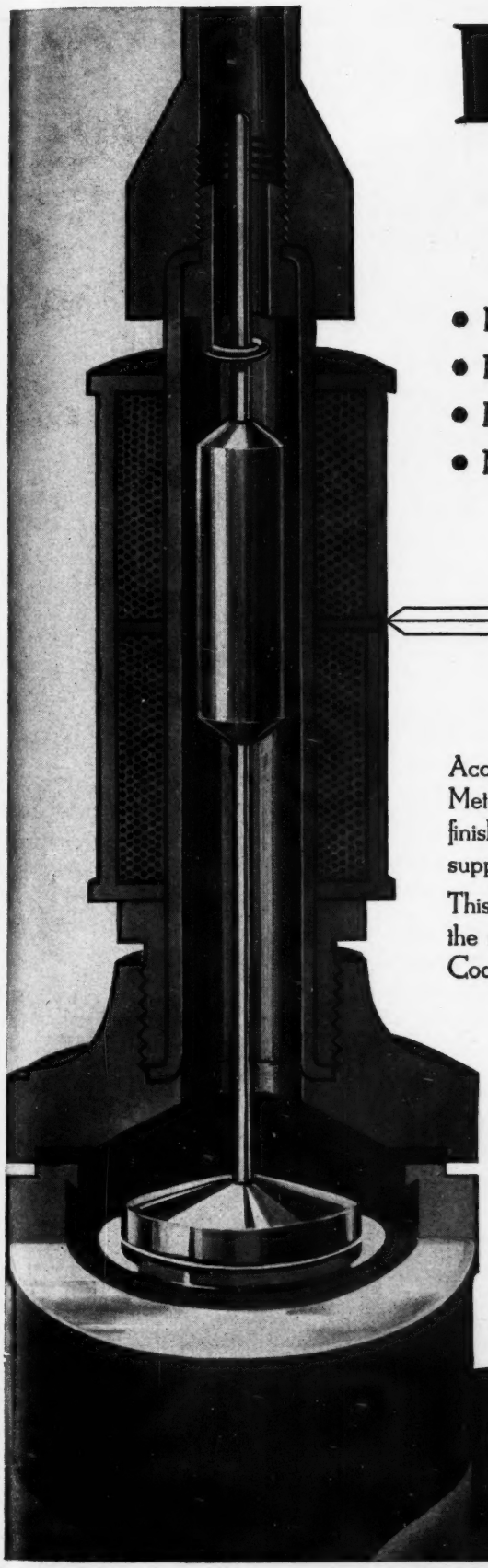
sion was the fact that spare tubes should be operated for short periods at intervals. This helps to maintain proper vacuum conditions and also insures that the "spares" are good tubes. With a.c. tubes, it was pointed out, the filament voltage should be out of phase with the anode voltage.

At the transformer loading session, Friday morning, W. C. Sealey of Allis-Chalmers, showed how, by the use of special radiators, the capacity of existing transformers could be boosted as much as 67 per cent.

It is impossible even to touch upon the many other interesting papers and discussions presented during the week. Many were outside the field of power. There was, for example, a fine description of a new electro-mechanical calculator for directional antenna patterns. This paper, presented by C. E. Smith of the United Broadcasting Co. was received without so much as a word of comment. The author had travelled from Hollywood, Cal., to present it. At the circuit breaker session on Thursday afternoon several improved types of oilless circuit breakers were described, one a 50,000 kv-a., 5 kv. metal-clad unit developed by Westinghouse Elec. & Mfg. Co.

A proposed wartime guide for industrial power distribution systems by the Committee on Industrial Power Applications, presented at a special conference met with considerable discussion, but apparently needed considerably more work before it could be acceptable. The use of women by utility systems to replace men drawn into service was a live subject and while a few utilities reported their use, so far there has not been much development in this direction. Women were reported to be functioning as meter testers, chemists, chauffeurs and telephone operators.

War workers' production ideas saved 1,250,000 man-hours in General Electric plants during 1942, according to a statement by the Company, announcing that a record $158,943 was paid last year for 16,204 suggestions adopted of 53,945 submitted. Besides the time, the statement pointed out, the suggestions adopted saved more than a million pounds of steel as well as large quantities of aluminum, copper, stainless steel, tin, chromium and other vital metals.

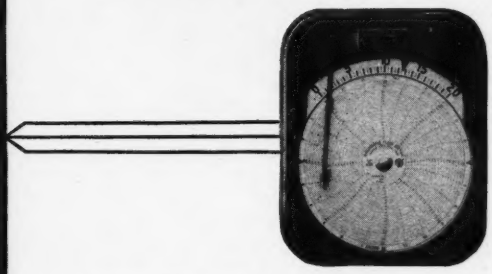


It Floats

...FREELY

$99\frac{44}{100}\%$ Frictionless

- **NO SOLENOID "REACTION"**
- **NO BEARINGS**
- **NO STUFFING BOX**
- **NO ELECTRIC CONTACTS**



Accuracy gets off to a good start in Cochrane Electric Flow Meters because the manometer is practically frictionless. The finish is strong, too, because at the receiver, this null system supplies high and equal power from 0 to 100% at flow.

This power comes from an auxiliary motor and not from the measuring circuit which is relieved of all work. The Cochrane Meter is a true null device.

Remember—

$$\text{Accuracy} = \frac{\text{POWER}}{\text{Friction}}$$

NOTE: A bridge circuit alone is not a null method meter. A galvanometer is required to detect unbalance and an external source of power is needed to restore balance. These are found only in the Cochrane Electric Flow Meter.

COCHRANE CORPORATION
3123 N. 17th St., Philadelphia, Pa.

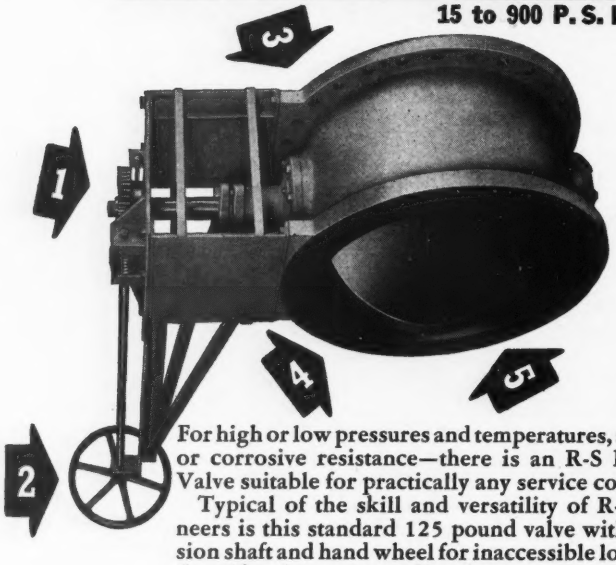
COCHRANE
FLOW METERS

Simplify

R-S QUALITY PRODUCTS SINCE 1908

Control and Shut-Off for Inaccessible Locations

15 to 900 P. S. I.



For high or low pressures and temperatures, abrasive or corrosive resistance—there is an R-S Butterfly Valve suitable for practically any service condition.

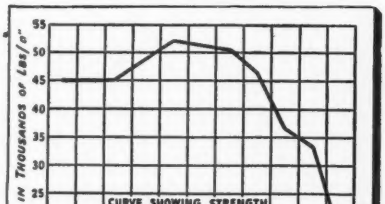
Typical of the skill and versatility of R-S Engineers is this standard 125 pound valve with extension shaft and hand wheel for inaccessible locations. Consider these outstanding features.

1. Oversize gear and worm.
2. Six hand wheel revolutions complete full vane movement.
3. Husky vane shaft mounted in grease-sealed stuffing box.
4. Body and vane can be cast of special R-S "A" or "Abrasive" metal for extra-long wear.
5. Beveled vane is precision machined—seats wedge-tight against valve body. Constructed to any A.S.M.E. dimensional standard. Sizes to 72-inches.

BUTTERFLY VALVE DIVISION

R-S PRODUCTS CORPORATION

4535 Gemantown Ave. • Philadelphia, Penna.



A SUBSTITUTE FOR STEEL!

R-S Engineers have developed special metals for resistance against heat, abrasion and corrosion. For example, R-S "H" Metal is an alloy semi-steel that machines like cast iron. Tensile up to 50,000 p.s.i. Withstands high pressures and penetration of steam and gases up to 1000°F. Stress relieved up to 1400°F.

Request detailed information and Catalog No. 10-B.

R-S Streamlined BUTTERFLY VALVES

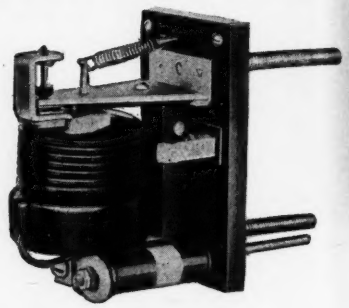
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING

Battery-Cutout Relay

AN AUTOMATIC battery-cutout relay, Type HAP, for use in ship service and in any application where batteries are charged from generators, has recently been announced by the General Electric Co., Schenectady, N. Y.

This relay performs practically the same function as the circuit cutout device in an automobile. When the battery voltage is lower than the voltage of the



charging source, the relay closes the charging circuit. When the charging voltage drops to a value below the battery voltage, the Type HAP cutout relay opens the circuit on a small reverse current.

Continuous current ratings available are 2.5, 4, 6.5, 10, 16, 25, 40, 65, and 100 amp. Voltage ratings are 7.5 v. (3-cell batteries) to 300 v. (120-cell batteries). The relay is set to pick up at slightly below the normal charging voltage.

Safety Extension Light

SAFETY extension light designed to be absolutely safe against electric shock, even when the guard is removed, has been developed by the Davis Emergency Equipment Co., Newark, N. J.

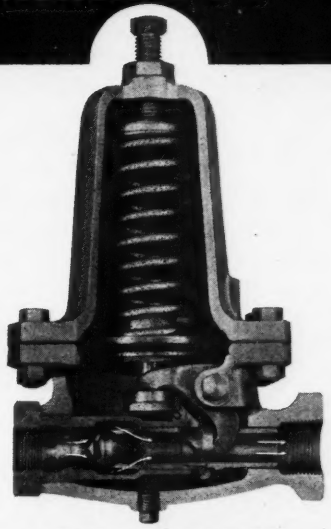
The light has a guard of heavy fibre and a new type of spring contact and is built so that when the guard is unscrewed the current is automatically cut off. The entire device is made of nonconductive materials. Bulbs are replaced quickly since the guard is removed without the use of tools.

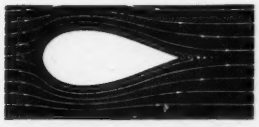
Slip-Proof Insulated Engine Mounting

A NEW, insulated engine mounting that reduces the amount of steel and rubber required by 17 per cent, available at low cost even in small quantities and yet can be had in almost any combination of metals and rubber, or synthetics, to suit individual requirements, is announced by Bushings, Inc., Berkley, Mich. The new line of support mountings, known as Rubberflex, are intended primarily to insulate vibration, absorb shock and com-

THEY'LL SEE YOU THROUGH WITH *Non-Stop Production . . .*

● Smooth, speedy, non-stop production is a vital thing today. It's a great advantage to have the dependability of operation—the smooth, even flow of steam, air, or oil—the better pressure control and greater capacity obtainable with the "1000" Valve. The Streamlined flow pattern you see at the right pictures for you the kind of valve action you get that is an important factor in keeping things going on your production front. Years after they have been installed, "1000" Valves perform so that you continue to realize all of the twelve benefits listed below. The "1000" is known as the "NO TROUBLE" Valve.





HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

POINTS THAT COUNT BIG IN YOUR FAVOR

You get all Twelve . . .

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

You can find out full details on all of the Type 1000 benefits by reading Bulletin "1000" —send for it!

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . .
VALVES

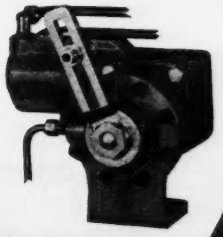
New CASH STANDARD *Remote* HYDRAULIC *Control*

●

Transmits oscillating motion without mechanical linkage

TYPE 550 SENDER

●Primarily used by aircraft manufacturers and aeronautical laboratories on engine test cells for controlling throttle position and mixture — this Type 550 Remote Hydraulic Control may fit your needs too. It is good for use where you desire to control apparatus remotely—without mechanical linkage. To operate, depress button in control lever with thumb. This releases the automatic brake. Move control lever to any desired position: release button, and control is automatically locked in that position, where it will remain indefinitely. The unit — A Type 550 Sender (above) and Type 550 Receiver (below), has positive hydraulic power in both directions — no springs, no cups on pistons. It transmits the total force applied to the control lever. There is no lost motion in either direction. The lever of the Receiver moves 90 degrees. It can be indexed to any position. For easy mounting, the bracket of the Receiver can be indexed to four positions. The Receiver can be installed above or below the Sender.



TYPE 550 RECEIVER

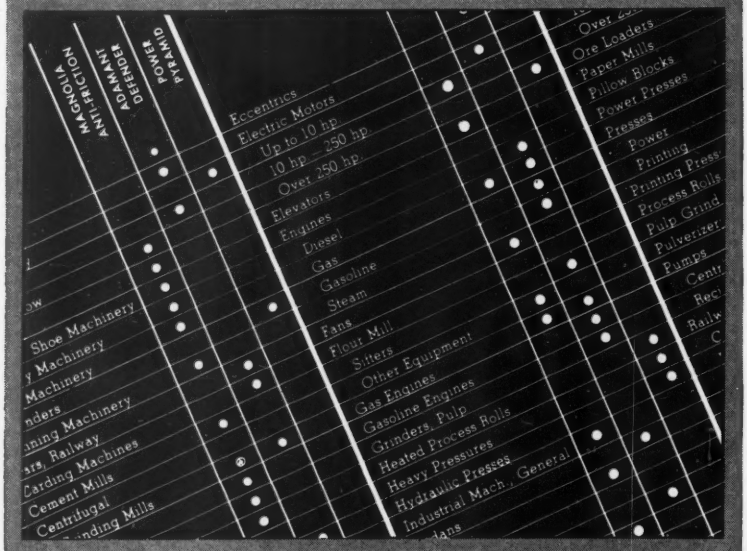
Write for Data

THERE IS A

PROPER BEARING METAL

FOR EVERY APPLICATION

It is impossible to incorporate in one bearing alloy all the physical characteristics needed to meet all possible working conditions. Average conditions call for good resistance to compression plus excellent anti-frictional qualities. Under extreme conditions some of the anti-friction qualities must be sacrificed to obtain either malleability or hardness. Insist on a bearing metal that has been "alloyed" for your particular application.



90% of bearings in use today are subject to uniform speed and only moderate pressures, as in electric motors, line shafting and general machinery. For such services, use Magnolia Anti-friction Metal.

When bearings are subjected to heavy sustained pressures, such as in rolling-mill machinery, use lead-base Pyramid or tin base Power, hard metals which will not squeeze out.

For shock loads, which would crack the harder bearing metals, use lead-base Defender or tin-base Adamant, tough yet malleable metals. Internal combustion engines and trap rock crushers are typical applications.

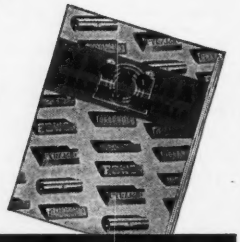
GENERAL USE

HEAVY LOADS

SHOCK LOADS

NEW BULLETIN

Write for FREE 8-page bulletin which gives many helpful hints on how to keep bearings on the job and shows what bearing metal to use where.



MAGNOLIA METAL CO.• ELIZABETH, N. J.

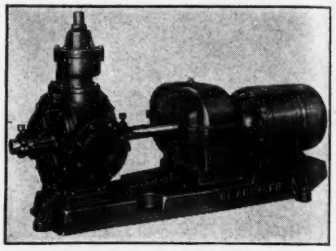
MAGNOLIA BEARING METALS

pensate for misalinement in heavy duty equipment. They are built for all types of internal combustion engines such as aircraft, tractor and tank engines, marine or stationary engines, even machine tools and similar equipment.

Pumps with Removable Liners

THE BLACKMER PUMP CO., Grand Rapids, Mich., has recently announced the start of production on a rotary pump with an improved removable liner.

This improved pumping unit operates on the same "bucket design" principle as all standard Blackmer pumps, but is so constructed that, when wear finally affects the capacity of a pump, the old liner may be easily removed, and a new one set in place. Neither piping nor drive



is disturbed, and normally the pump can be back in operation in ½ hr. Due to self-adjusting buckets no fitting is necessary. The anchoring mechanism has been simplified, cam bore changed, and the intake and discharge ports streamlined to handle more viscous liquids and increase the volumetric efficiency of the pump.

The pumps, with improved removable liners, are being made in capacities from 20 to 750 g.p.m. and pressures up to 300 psi.

Solenoid Motor Starter

A NEW Thermaload V Solenoid motor starter was recently announced by the Monitor Controller Co., Baltimore, Md., which incorporates many features usually found only on large controls. Its small size, 5¾ by 5¼ by 4⅛ in., permits installation in small spaces and indicates good, compact design.

The principal feature of the Thermaload V starter is the Monitor Bi-metal Compensated Overload Relay which permits perfect starter operation under extremes of ambient temperature. Full overload protection is assured because the trip always occurs within the same time at a given percentage of overload. The motor is further safeguarded by an arrangement which prevents the operator from improvising any method to hold the starter button in the "on" position, thus preventing the trip when overload occurs. The operator must press the button and release it before contact is made.

The Monitor Thermaload V is available in five sizes, 1½ to 7½ hp. and 110 to 550 v. a.c.

Synthetic Rubber Mountings

THE B. F. GOODRICH CO., Akron, Ohio, announces that its line of Vibro-Insulators (rubber mountings) can now

M
Maritime Commission "M"
awarded to
THE M. W. KELLOGG COMPANY
SHIPS FOR VICTORY
Dedicated to the Men of the Merchant Marine, Guardians of the Life-line between all the United Nations.
HEAT TRANSFER DIVISION
THE M. W. KELLOGG COMPANY
225 BROADWAY, N. Y.
JERSEY CITY, N. J.

NUGENT *Duplex* FILTERS

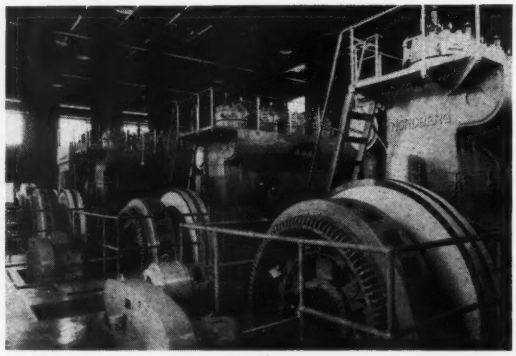
Help Protect NORDBERG *Diesels*

at the

Hampton, Ia.

REA

Plant



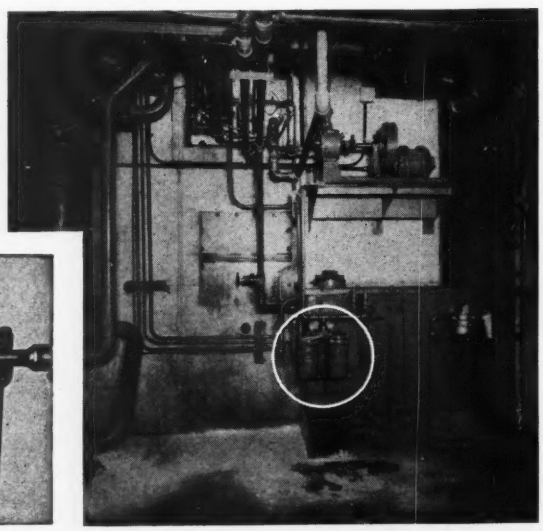
WHEN the demands of war tax the generating capacity of power plants it is more important than ever to eliminate the possibility of shut-downs. At the Federated Co-op power plant at Hampton, Iowa, Nugent Duplex Filters help to insure uninterrupted service by eliminating dirt from the fuel oil used in the Nordberg Diesels.

These rugged filters will remove particles as small as .0003" to produce 99 8/10% clean oil . . . and *clean oil* is essential for smoother, more dependable diesel operation.

Perhaps Nugent can help you on your own oil conservation problems. Write today.

The duplex unit illustrated below (Fig. 1116 SV#O) assures you of continuous protection year in and year out. Nugent's special woven, acid resisting, lintless textile filter element means *cleaner oil.* And you get 20 times more filtering surface than with most filters of comparable size. Duplex units are offered in five sizes.

The illustration at the right shows a Nugent Duplex Filter for filtering fuel oil for one of the Nordberg Diesels.



WM. W. NUGENT & CO., INC., Established 1897

423 N. Hermitage Ave., Chicago, Illinois

be made using its Ameripol synthetic rubber. These mountings, which are used for the isolation and insulation of vibration, shock and noise, have been offered for many years using natural rubber bonded to metal.

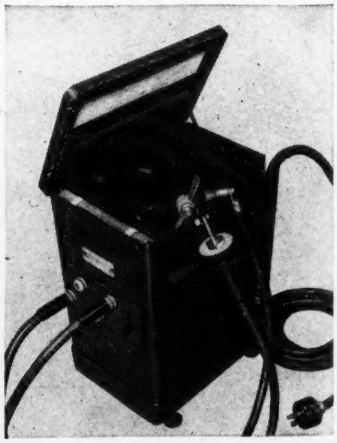
Vibro-Insulators made of Ameripol synthetic rubber are expected to find wide application in many fields of war industry where the action of oils, grease, paint, fatty acids or heat result in too-rapid deterioration of natural rubber used on mountings.

Most Vibro-Insulators, whether made of natural rubber or synthetic rubber, are designed to carry the load in shear, because rubber in shear is known to have six times the resiliency of rubber in compression.

The insulators can be cited chiefly for performing these varied functions: Reduce wear and tear on important—and often non-replaceable—machinery; aid in the manufacture and operation of precision instruments and equipment; produce products of necessary higher quality; eliminate noise and vibration that is distracting to production and office personnel; prevent transmission of sound or vibration from one building or one piece of apparatus to another; increase the efficiency of machine operators and prevent eventual structural weakening or destruction of buildings.

Electrical Metallizing

METALLIZING ENGINEERING CO., INC., Long Island City, N. Y., announces a new Fuse-Bond process with equipment for its application for preparing machine components and similar metal parts for metallizing electrically. The main advantage of the process is said to be that it provides an adequate bond on the hardest surfaces, heretofore impossible or impractical to prepare by blasting or rough threading.



The Metco Fuse-Bond Unit is used for applying the process. When operating on any 110 or 220-v. single-phase power line, this equipment fuses a rough deposit of electrode metal into the surface to be metallized. Electrodes are applied to the work with a special holder which uses up to six electrodes at a time, depending upon the size and nature of the part to be prepared. The Fuse-Bond Unit is extremely compact, weighs 170 lb. and is contained in a portable cabinet 24 in. high. All cables and attachments fit into a bin in the top of the cabinet.

Now, when Industry needs it most, the Gilmer National Power-Recovery Plan steps forward to increase available power by cutting down on power-waste. Practical Power-Recovery Estimators do the job . . . skillfully designed to meet the needs of these services: Electricity, Gas, Water, Steam, Mechanical Transmission, Compressed Air, Refrigeration, Boilers, and Prime Movers.

"*Two Boulder Dams Worth of Power*" are made available through the Gilmer Plan. If you want your share, then now is the time to put it to work. There's bound to be a spot in your plant where the FREE Gilmer Booklet and Charts can effect important and needed savings. Write to Gilmer today . . . no cost or obligation for this plan.

"This type of work is a genuine contribution to the war effort," Hoffman Beverage Company; "You have done a fine piece of work . . . made a substantial contribution to Power Conservation," Texas Power & Light Co.; "We feel this is a very good thing," The Celotex Corporation; "Want to congratulate you upon your National Power-Recovery Plan," Leeds & Northrup; "Well explained in the booklet," Johnson & Johnson.

AND HERE'S ADDED HELP FOR BELT PROBLEMS:

To help you choose the correct Gilmer Belt for every purpose, we offer the Gilmer Handy Belt Selector. It solves your needs at a glance, whether for V-Belts, Flat Belting, Round Endless Belts, Belts for Textile Machinery, or for special purposes. Write for it . . . *today.*

Gilmer BELTS

L. H. GILMER COMPANY
TACONY, PHILADELPHIA, PA.
The Oldest Firm of Rubber Belt Specialists

L. H. GILMER COMPANY
Tacony, Philadelphia, Pa.

Gentlemen: Please send me, without cost or obligation:

☐ The Gilmer National Power-Recovery Plan
☐ The Gilmer Handy Belt Selector

NAME & TITLE _____

COMPANY _____

ADDRESS _____

Safeguard
.. YOUR MEN
.. YOUR PROPERTY
.. PRODUCTION
WITH

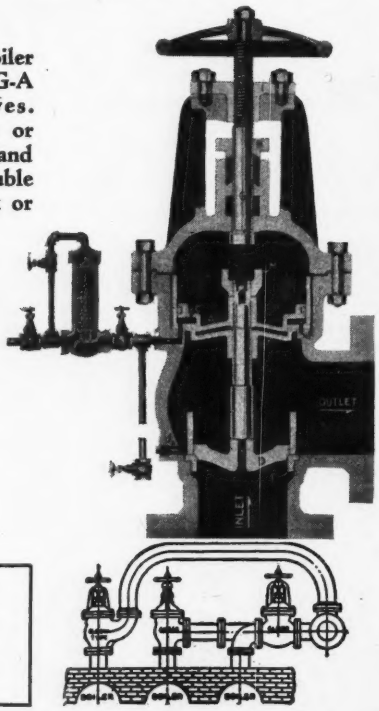
GOLDEN-ANDERSON

Triple-Acting ★ Non-Return

VALVES

You can make safety in your boiler plant a certainty when you use G-A Triple-acting Non-return Valves. There'll be no boiler explosions or bursting steam lines to damage life and property when you use this double cushioned valve that will not stick or chatter.

Comes with either flanged ends or welded necks, and handles 150 lbs., to 1500 lbs. Test it under pressure. It's the heaviest valve of this kind made. In angle, globe, or elbow types from 2½ in. to 16 in. in size. Free G-A catalog describing complete line will be sent to you upon request.



Also Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves, etc. . . . . .

GOLDEN-ANDERSON VALVE SPECIALTY CO.
FULTON BUILDING • • • PITTSBURGH, PA.

Car Spotter

ANNOUNCEMENT is made by Link-Belt Co., 2410 West 18th St., Chicago, Ill., that the Link-Belt line of motorized electric car spotters, heretofore furnished only for stationary mounting, is now available in portable form.

The spotter is so balanced on a channel iron frame that one man can lift

the one end and roll the unit to any desired location. The frame is anchored with a chain, an electric cord plugged into nearest power outlet, one end of haulage cable is hooked to car or object to be moved, the other end wrapped around capstan and the spotter is ready for operation.

Arc Welding Control

A UNIQUE type of arc welding control, which enables the welder to speed up his work and do a more accurate job is announced by The Lincoln Electric Co., Cleveland, Ohio.

This control, called the "Lincontrol", is strapped onto the welder's foot and enables him to move about with it freely.

It is specially intended for aircraft welding, but is applicable for welding of light-gage sheet metal of all kinds. Because it is so easily used, it may prove to be a boon to women welders, who are taking up this type of work in aircraft plants in increasing numbers.

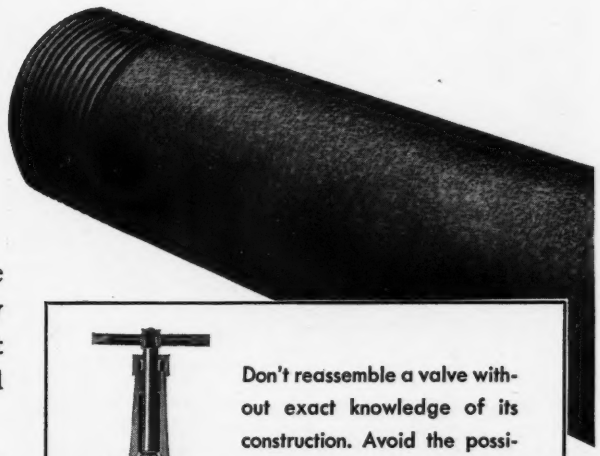
With the control strapped to his foot, the welding operator merely presses down on the pedal which moves the pin to operate a current control. As he exerts pressure he increases the current.

Automatic Transfer Switch

A NEW improved automatic transfer switch has recently been introduced by Zenith Electric Co., 152 W. Walton St., Chicago, Ill. It is said that this switch eliminates interruption and lag in the transfer of a load from normal to emergency service.

Operation is instantaneous and positive, and is so designed that all contacts are carried on one shaft and operate in the same direction. Contacts are either in the normal or emergency position, no "off position" being possible. One mag-

DON'T CUT OVERLENGTH THREADS ON PIPE!

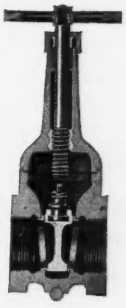


Overlong threads on the pipe may strike the diaphragm of the valve and distort it, or may make it impossible to get a tight joint without the use of excessive amounts of joint compound —or other inadequate practice.

So, when cutting threads on the pipe, work to the gauge length established by standard. Do not exceed standard dimensions and standard tolerances.

Blow out the new line—and the valve—to make certain that no grit will be deposited on the valve seat. Then apply joint compound to the *pipe* threads—*not* to valve threads.

Take precautions such as these to guard your valves for the duration.



Don't reassemble a valve without exact knowledge of its construction. Avoid the possibility of ruining a valve—and having a costly shut-down—by consulting the valve manufacturer's catalog.

Write to Reading, Pa., general office, for copy of "VALVE DON'TS" —a poster for plant use that tells things NOT to do to valves.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

A reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.

"Our gauge glasses are perfectly illuminated"

"This is a modern power plant," explained the Chief, "carefully planned to the last detail. There's a light over every gauge glass, so they're very easy to read. A red lined glass would undoubtedly help in some plants, but it's unnecessary here."

The fact is, however, that PYREX Broad Red Line Gauge Glasses are easier to read *anywhere*, in a well-lighted or a poorly lighted situation. Hang a small calendar and a big one on the wall. The big one is easier to read from across the room, *in any kind of light.* So is a PYREX Broad Red Line Gauge Glass—incomparably easier to read from a distance. That's a safety feature, as you well know. And it's a feature that saves steps and saves time.

They also last longer, and that's your first demand. They're made of PYREX brand borosilicate glass—the same type of glass in which your wife likes to bake, and store things in the refrigerator—the same type of glass the chemical industry uses for piping because of its extraordinary resistance to corrosive action.

Next time, tell your jobber it's PYREX Broad Red Line!

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

NEW TRIM SIZE

Effective with April issue

In order to comply with Paper Limitation Order No. L-244, the trim size of POWER PLANT ENGINEERING will be reduced effective with the April, 1943, issue, from 8¾ in. by 11⅝ in. to 8⅛ in. by 11¼ in. It will then be the "standard" size adopted in general by publications in this field and recommended by N. I. A. A.

POWER PLANT ENGINEERING, 53 W. Jackson Blvd., Chicago

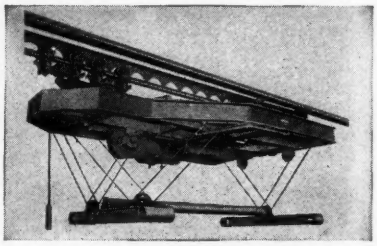
net frame with the coil connected to the normal supply line holds the normal contacts closed and the emergency contacts open during normal operation. On failure of the normal service the normal contacts open by gravity and the emergency contacts close by means of individual compression springs on each contact. On resumption of normal service the magnet closes the normal contacts and opens the other sources of supply. The switch can be set for timed automatic supply when desired.

Units are made to operate from a.c. to a.c., a.c. to d.c., or in any combination. The switch is furnished in 1, 2, 3, and 4-pole types and 18 capacities from 30 to 600 amp., and is said to be built of the finest materials, compactly mounted on ebony asbestos panel.

Stabilized Tramrail Carrier

THE CLEVELAND Tramrail Division of The Cleveland Crane & Engineering Co., Wickliffe, Ohio, announces a new Stabilized Tramrail Carrier, that solves one of the oldest problems in hoisting, that of suspending a load rigidly with the use of the usual flexible hoisting ropes.

By an arrangement of the ropes to form a triangular suspension, a load can be held rigidly in place so as to eliminate longitudinal, lateral and rotational sway. The rope angles have a definite relation to one another and have been worked out according to a mathematical formula.



A load can be raised or lowered through a considerable distance and yet with nothing more than the hoisting ropes supporting it, will remain as rigid as if guided in an elevator shaft. Further, even if the load should be considerably unbalanced, the carrier will hold it rigidly in place.

Another very desirable advantage of the carrier is the feature permitting the tilting of a load in either direction with relation to the rail on which the carrier is propelled. If it is desirable to rotate the load, this may be accomplished through use of a trunnion-type load bar. Thus in most cases it is possible to place any part of a load in any position that will be most convenient and accessible.

Stabilized carriers have been built for capacities of one, three, and five tons, some hand-propelled and some electrically-propelled, but all with motor-driven hoist. They may be built for various capacities and speeds to suit individual requirements.

Diesel Fuel Concentrate

TO PROVIDE better fuel combustion and top-cylinder lubrication for Diesel engines, a new product, known as Diesel Fuel Concentrate, has recently been developed by E. F. Houghton & Co., 303 Lehigh Ave., Philadelphia, Pa. This concentrate, used in the proportion of 5

WeldELLS have everything ★

FULL WALL THICKNESS HERE
The amount by which stress is greater at the crotch in a fitting having uniform wall thickness depends only on its radius. Mathematical analysis (specifically the Lorenz formula) shows the stress at the crotch to be:
$S = \frac{pr\,(2R - r)}{2t\,(R - r)}$
Where:
S = Bursting stress, lbs. per sq. in.
p = Internal pressure, lbs. per sq. in.
r = ½ inside diameter of fitting (O.D. if Barlow's formula is desired).
t = Wall thickness in inches.
R = Center line radius of fitting, inches.
REINFORCED HERE

It's a feature that tells the whole story . . .

TO the kind of engineer we're thinking about, *nearly right* is not right enough. He's the kind of fellow who makes sure that the strength of every part is as nearly proportionate to the stress imposed on it as exacting calculation can make it. To him, nothing less is *right*.

The feature of WeldELLS, pictured above, is certain to strike a responsive chord in such a man. It is based on mathematical calculations and practical tests which prove that the bursting stresses in an elbow are greatest at the crotch or inner wall —and show just how much greater.

In keeping with this finding, WeldELLS are given extra reinforcement in this region of greatest stress. To us, as to you, nothing less would be right!

We are not implying that welding fittings which lack this feature are bursting right and left. We are simply showing that in this, as in other features listed opposite, we have gone the engineering limit to make WeldELLS the fittings that have *EVERYTHING*.

Don't you agree that nothing less is right for *your* piping job.

★ No other fittings for pipe welding combine the features found in WeldELLS. In addition to that described, they include:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress — simplify lining up.
- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** —assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** —insures complete service and undivided responsibility.

PRODUCTS VITAL TO MODERN WARFARE

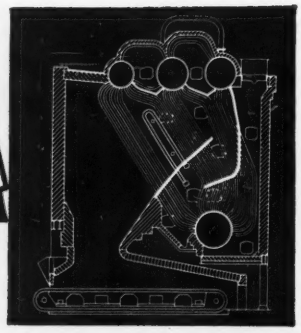
WeldELLS are only one of many Taylor Forge contributions to the war effort. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant and fighting ships.

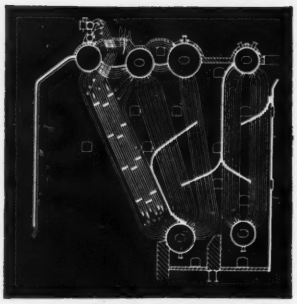
TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485

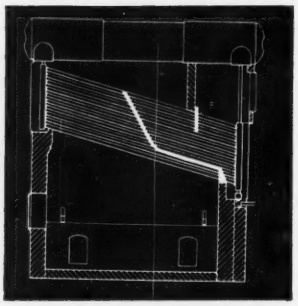
NEW YORK OFFICE: 50 CHURCH ST. • PHILADELPHIA OFFICE: BROAD ST. STATION BUILDING

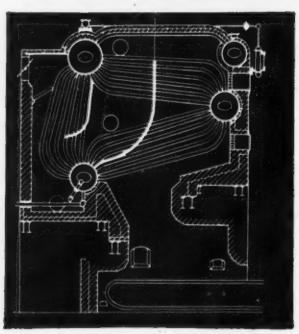
MORE STEAM

Procurable with Improved Baffles









Demands for greater boiler output are often met by installing more efficient baffles.

Overload operation need not be destructive nor cause serious outages due to furnace failures when the heat path through the boiler is well designed.

Enco baffling boosts steam output safely. The cross flow puts every foot of heating surface to work. The streamlining prevents eddy currents and dead gas pockets.

Enco baffles also cut down draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are used more effectively and less often. They can be applied to any water-tube boiler.

Each application is individually designed by men with 25 years experience in this highly specialized branch of engineering. Installations are made by skilled mechanics.

● ***A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.***

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

gal. per 1000 gal. of fuel oil, is a blend of high-quality oils with stable synthetic organic compounds of high boiling point.

It is designed to aid materially in solving Diesel engine problems of ring and valve sticking, sludge or gum deposits, carbon, injector contamination and piston or cylinder wear and thus to assure reduced operating temperatures and less blow-by, a smoother running engine with freer valve action, less gum and lower maintenance cost.

Gear and Wheel Pullers

ARMSTRONG-BRAY & Co., Chicago, Ill., announce two new additions to their line of Steelgrip Rigid-arm Gear and Wheel Pullers, the No. 1001 and No. 1002. These new pullers will pull anything up to their rated capacity and within their arm's reach, the No. 1001 having a 3¼ in. reach from end of shaft and the No. 1002 a 5½ in. reach from end of shaft.

These new pullers are of rugged construction, the forged steel arms, forcing screw, etc., are heat-treated for great strength. The No. 1001 will take gears, wheels, etc., up to 6 in. in diam., and the No. 1002 will take gears, wheels, etc., up to 8 in. in diam.

Concrete Preserver

A NEW transparent penetrating liquid has been developed by Evercrete Corp., 19 W. 44th St., New York City, to make concrete not only permanently dustproof but also waterproof and crumbleproof, thus greatly increasing its resistance to traffic and preventing the formation of ruts and holes.

This compound is applied by putting the liquid in a pail or watering can, flushing on the floor and sloshing it around evenly with a long handled broom or brush until the concrete will not absorb any more. It penetrates immediately and can be applied during working hours.

It is described as an excellent binder for surfaces that are to be painted for it is said to keep the moisture from entering and locks in the lime and alkalies, preventing burning off or hot spots on painted surfaces.

Spot Welding Control

A NEW electronic half-cycle, synchronous control for the precise operation of resistance-welding machines is announced by the General Electric Co., Schenectady, N. Y. Mounted in a protecting cabinet, the control is furnished in two types, the CR7503-A136, which includes a welding transformer and is designed for bench mounting; and the CR7503-A133 which does not have a transformer and is designed for wall

Fig. 241

Millions of human beings depend on Boulder Dam to perform the function for which it was designed.

In the Power field, valves perform many important functions. And above all—day in and day out—they must perform these functions dependably.

For nearly a century Powell Engineering has been designing valves to meet all requirements for precise flow control under any and all conditions. And Powell engineering, Powell materials and Powell workmanship have made these valves above all things—*dependable*. That's why today the flow through so many of the power lines of America is controlled by Powell Valves.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati, Ohio

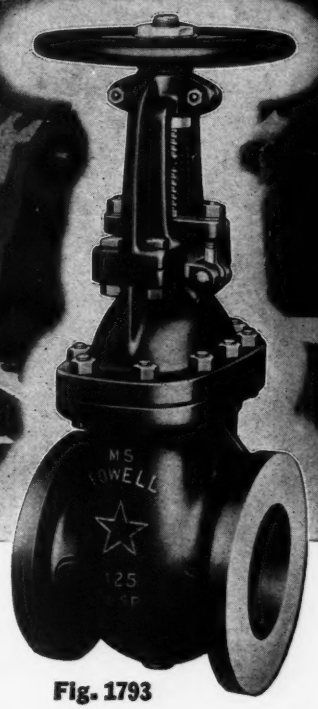


Fig. 1793

Fig. 1793—A large size Iron Body Bronze Mounted Gate Valve with flanged ends, outside screw rising stem, and taper wedge solid disc. Made in sizes 2" to 30" inclusive, for 125 pounds W. P.

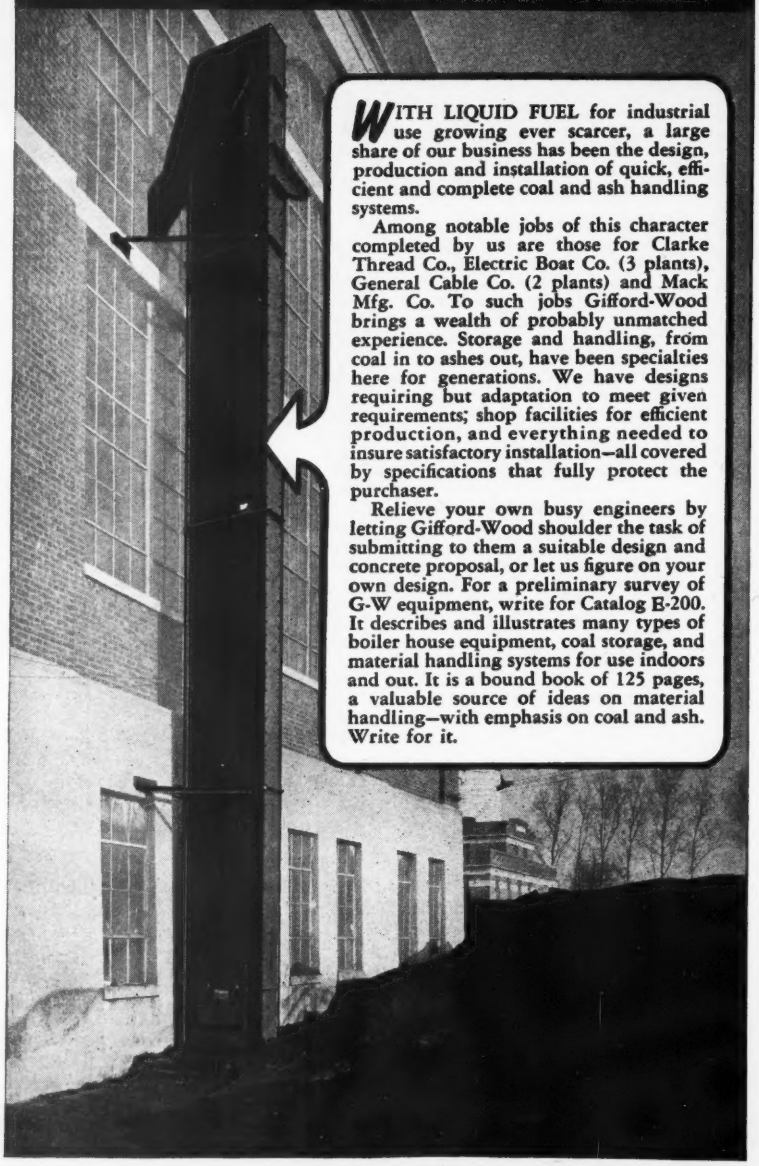
Also available with taper wedge double disc—Fig. 1444—sizes, 2" to 12", inclusive.

Fig. 241—An Iron Body Bronze Mounted Regrinding Globe Valve with flanged ends, outside screw rising stem and bolted flanged yoke. Made in sizes 2" to 12", inclusive, for 125 pounds W. P.

The complete line of Powell Valves includes Globes, Angles, Gates, Checks, Reliefs, Y's, Non-returns, etc., in bronze, iron, steel, pure metals and special alloys to handle ever-increasing pressures and temperatures.

POWELL VALVES

For QUICK CONVERSION to COAL come to GIFFORD-WOOD



WITH LIQUID FUEL for industrial use growing ever scarcer, a large share of our business has been the design, production and installation of quick, efficient and complete coal and ash handling systems.

Among notable jobs of this character completed by us are those for Clarke Thread Co., Electric Boat Co. (3 plants), General Cable Co. (2 plants) and Mack Mfg. Co. To such jobs Gifford-Wood brings a wealth of probably unmatched experience. Storage and handling, from coal in to ashes out, have been specialties here for generations. We have designs requiring but adaptation to meet given requirements; shop facilities for efficient production, and everything needed to insure satisfactory installation—all covered by specifications that fully protect the purchaser.

Relieve your own busy engineers by letting Gifford-Wood shoulder the task of submitting to them a suitable design and concrete proposal, or let us figure on your own design. For a preliminary survey of G-W equipment, write for Catalog E-200. It describes and illustrates many types of boiler house equipment, coal storage, and material handling systems for use indoors and out. It is a bound book of 125 pages, a valuable source of ideas on material handling—with emphasis on coal and ash. Write for it.

3655

GIFFORD-WOOD CO.

FOUNDED 1814

420 Lexington Avenue
New York

HUDSON, N. Y.

565 W. Washington Street
Chicago

Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes
Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers
Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

mounting. Both types can be used either with tongs or with a suitable bench welder.

Principal features of the control are the new, easily replaced GL-415 tube; a new circuit which makes higher-speed welding possible; and a simplified initiating circuit which improves performance and reduces maintenance. The new design also incorporates heat control by the phase-shift method, the heat adjustment being made by a dial mounted on the front of the cabinet.

This new control is said to facilitate the welding of tinned copper, steel, or alloy wires; of studs from 0.01 to 0.05 in. diam. to flat surfaces, with little or no indentation on the opposite surface of the metal; and the spot welding of unusually thin (less than 0.01 in.) pieces of stainless or mild steel, nickel, or silver to brass or bronze, with little oxidation or discoloration.

With this control it is possible to weld low resistance joints which are not affected by temperatures considerably in excess of 125 deg. F., the point at which certain types of soldered joints weaken and often collapse, resulting in a saving of tin and approximately 50 per cent in time.

MANUFACTURERS' PERSONALS

Robins Conveying Belt Co., Passaic, N. J., announces the appointment of John T. Hoyt as comptroller and R. C. Gray as works manager.

E. F. Drew, president of E. F. Drew & Co., Inc., New York City, announces the appointment of Robert Bruce as advertising and publicity manager. Mr. Bruce was formerly managing editor at Prentice-Hall, Inc., and also headed the Business Research Division of that company.

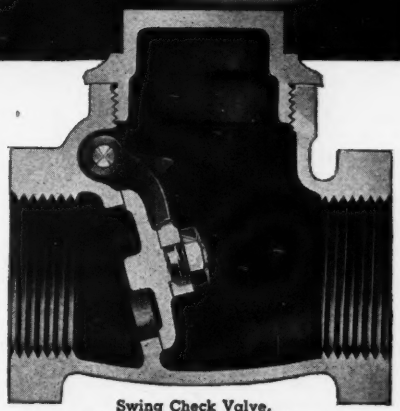
Announcement is made by Peerless Pump Division, Food Machinery Corp., of the appointment of Dan R. Rankin as acting chief engineer of the company. Rankin has been associated with Peerless for the past 5 yr. and previously was assistant to the chief engineer. Continuous research in the field of hydraulics is being carried out under Rankin's direction in the recently enlarged Peerless laboratory.

A. J. Rogowski, former development engineer at the Harrison Works of Worthington Pump & Machinery Corp., Harrison, N. J., has been named works engineer and will have supervision of the power plant, succeeding the late Christian Hipp. Mr. Rogowski, a graduate of Massachusetts Institute of Technology in 1934, worked at the Brooklyn Navy Yard and in 1935 came to Worthington. He was appointed development engineer in 1940 and recently has been working on the construction and design of the new building for the Research and Development Department.

J. L. Poyas has been appointed by Quaker Rubber Corp. as their Houston branch manager. During World War I, he served in the Engineering Corps in France. On his return to the United States he worked up from general office experience to become assistant branch manager, before becoming an

An Occupational Questionnaire for CHECK VALVES

Since valve materials are on the critical list . . . and valves are becoming increasingly hard to obtain, even by war plants . . . it is doubly important that the right valve be selected for each installation. Before deciding on a particular type of CHECK VALVE, read the following suggestions for proper application.



Swing Check Valve,
Bronze or Leather-faced Disc

WHEN MAY SWING CHECK VALVES BE USED? Swing check valves operate best on horizontal lines. If used on vertical lines or at an angle, they should be installed so that the flow will be upward through the valve.

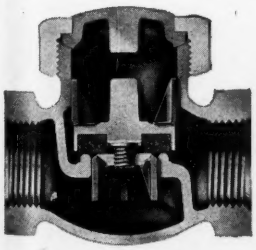
WHAT ARE THE ADVANTAGES OF LIFT CHECK VALVES? Lift check valves have less tendency to slam than swing check valves. They can be fitted with a spring to eliminate chattering and pounding where the flow is irregular or subject to quick reversal.

WHERE SHOULD VERTICAL CHECK VALVES BE USED? Vertical check valves should be used on vertical lines only, and with the flow upward through the valve.

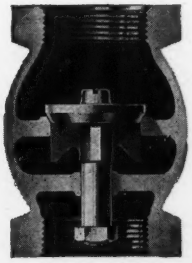
WHAT PLANTS SHOULD HAVE NON-RETURN STOP AND CHECK VALVES? Every plant using more than one boiler should have a non-return stop and check valve between each boiler and the main header. These valves are a necessary safeguard to boilers as they close automatically in case the pressure in a boiler is reduced by a tube rupture, boiler shut-down or other cause. The valve remains closed until the boiler pressure equalizes with that of the header. It then opens automatically and promptly, and can be closed manually whenever desired.

WHEN ARE COMPOSITION DISCS SUITABLE? Check valves with composition discs are suitable for pressures up to 150 lb. steam.

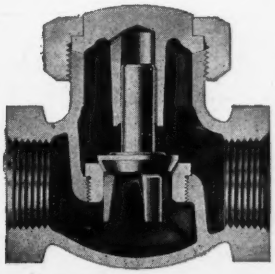
FOR WHAT SERVICES ARE METAL DISCS PREFERABLE? Metal discs for check valves are preferable for high temperatures and for severe service.



Lift Check Valve,
Renewable Composition Disc



Vertical Check Valve,
Bronze Disc



Lift Check Valve,
Renewable Alloy Disc and Seat Ring

When you are up against a valve selection problem, write us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased recommendations for the correct selection of equipment. Send for copy of the 240-page Kennedy Catalog, illustrating and describing Kennedy products.

KENNEDY VALVES • PIPE FITTINGS • FIRE HYDRANTS
THE KENNEDY VALVE MFG. CO. • ELMIRA, N. Y.

One glance inside the case of a Frahm Tachometer shows its striking simplicity. The sole mechanism is a set of accurately tuned steel reeds which pick up the minute vibratory impulses of the machine which the instrument need merely touch, and the R.P.M. is indicated on the scale by a sympathetically vibrating reed. Because *no contact with the rotating element is required,* these instruments solve troublesome problems of indicating speed . . . without belts, gears, flexible shafts or electrical connections.

This principle and the method of indication are unique among speed measuring instruments. The Frahm Resonant-Reed Tachometer is as accurate as it is simple, with no parts to wear, adjust, lubricate or renew. It can be used in any position and will give years of trouble-free service. Built in types for permanent mounting . . . and for hand use in servicing, installation and maintenance work. Various ranges available from 900 to 30,000 R.P.M.

For a complete description of Frahm Tachometers together with lists of types and ranges commonly supplied, write for Bulletin 1590PE.

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA, PENNA.

active outside salesman, in which capacity he has served for the past several years.

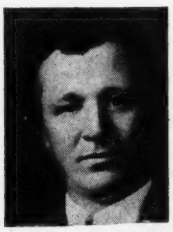
H. M. Sossaman, former Houston branch manager, returns to the main office at Philadelphia to take an active part in the Sales Division, becoming one of the assistants to the general sales manager, G. C. Johnson.

Dr. Albert W. Hull, assistant director of the General Electric Research Laboratory, was elected president of the American Physical Society at its meeting in New York in January. The society, which numbers about 4000 members, includes the nation's physicists, as well as scientists working in allied fields. Dr. Hull, a native of Southington, Conn., was graduated in 1905 from Yale University, where he also obtained his Ph.D. in 1909. After 4 yr. as instructor and as assistant professor of Physics at Worcester Polytechnic Institute, he joined the G-E Research Laboratory staff in 1914 as research physicist. In 1918 he was made assistant director.

Announcement has been made by E. P. Stevenson, president of Arthur D. Little, Inc., that Roger C. Griffin of Needham, Mass., son of Roger B. Griffin who with Arthur D. Little founded the organization in 1886, was elected vice-president, and Henry G. Powning of Manchester, Mass., succeeds him as treasurer. Frank N. Houghton of Elmwood, Mass., was elected secretary and Russell H. Stephens of Newton, comptroller. Mr. Stevenson as president, Raymond Stevens and Thorne L. Wheeler, vice-presidents, were re-elected. Directors for the coming year are: Earl P. Stevenson, Henry G. Powning, Roger C. Griffin, Horace S. Ford, W. Cameron Forbes, Randolph C. Grew, Royal Little, Charles E. Spencer, Jr., Alexander Whiteside.

M.A.P.I. Promotes Kiessling and Terborgh

OSCAR E. KIESSLING of Washington, D. C., is the newly elected secretary of the Machinery and Allied Products Institute, succeeding George Terborgh who has been advanced to the position of research director.



O. E. Kiessling

George Terborgh

Mr. Kiessling, an economist by profession, brings to the Institute 15 yr. experience with the United States Bureau of Mines, The National Research Project, and the Bureau of the Census, having been since 1939 Chief of the Mineral Industries Division of the Census. He has written and lectured extensively on the production and technology of minerals.

How Lubrication Engineering Saves...

gallons of oil...hours of down-time...scarce repair parts...and reduces hazards

HERE'S an example of the materials and money you may save if you let a Standard Lubrication Engineer analyze troublesome lubricating problems.

This was the job. A central state war plant operated a steel scrap baler. A hydraulic pump and cylinders compressed the steel. Air cylinders pulled back the hydraulic ram for quick-return.

Some of the problems. Leakage and sludging were troublesome on the hydraulic system. The floor around the pump and valves was continually soaked with oil—a definite labor and fire hazard. It took 100 to 150 gallons of oil per month to operate the unit. Wear on pump and cylinder packings was excessive.

On the air cylinders, synthetic rubber piston rings were being replaced every few days, at a cost of $16.00 each, plus labor and lost machine time.

...reduces hazards

...saves costly rings

What the Lubrication Engineer did. He found that paraffine oil was being used in the hydraulic system. The high operating temperatures lowered the viscosity of this oil, resulting in poor lubrication, wear, and leakage. He recommended Stanoil—an oil particularly suited for hydraulic systems because it changes less in viscosity over a wide range of temperatures. This means that, at low temperatures, it flows readily to the pump when starting, and still maintains its lubricating quality at higher temperatures. It also resists deposit formation, frequently troublesome in these systems. Evidence that Stanoil cured the leakage trouble was shown, not only by the clean, safe, oil-free condition of the floor around the unit, but also by a drop in oil consumption from over 100 gallons per month to 25 gallons per month in the two months since Stanoil has been used.

When the air cylinders were examined, they were found to be pitted and rusted. A special oil, developed for lubricating air drills, was recommended. In spite of the pitted cylinder walls, which have not been reconditioned, this oil is giving such excellent lubrication that no synthetic rings have been replaced in two months. Cylinders are entirely rust-free.

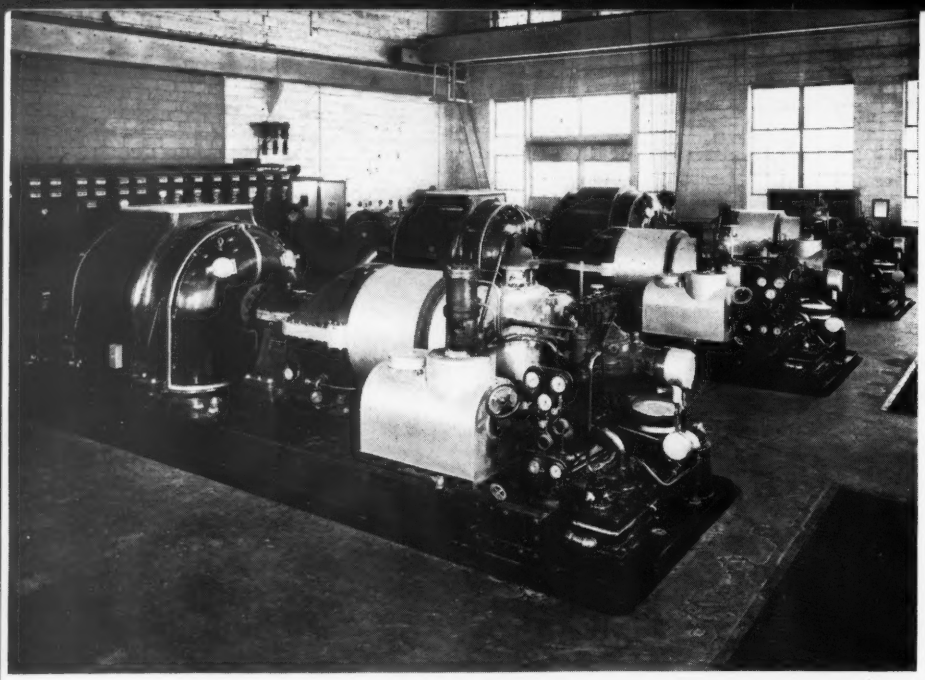
...reduces oil consumption

As a wartime measure Standard Lubrication Engineers are available, at a moment's notice, to all plants producing war materials in the Middle West. Just call the nearest Standard Oil Company (Indiana) office, or write 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you when any problem involving lubrication develops.

STANDARD OIL COMPANY (INDIANA)

Oil is Ammunition...Use it wisely

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENG



Records made on the three turbines above show how clean turbine oil systems stay with Nonpareil Turbine Oil.

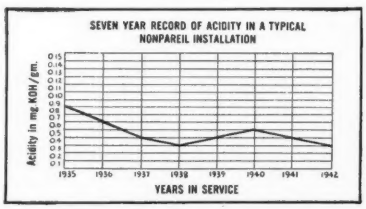
Service record shows how to get cleaner turbine operation

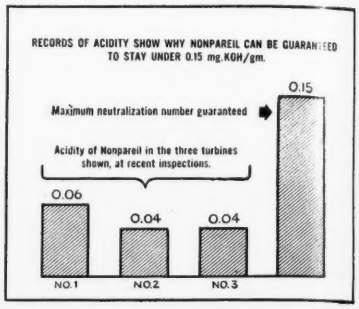
A comparison of turbine oil operation is difficult to make. Conditions vary from plant to plant. The type of turbine, and operating practices and needs affect oil performance. But here is a case where conditions were, as nearly as possible, identical—where the performance of an oil that is fully protected against acidity and sludge formation could be fairly rated in direct comparison with a conventional oil.

Here are the conditions. The three 1500 KW turbines in a middle western power plant, shown above, are the same make. All operated eight years on Nonpareil Turbine Oil. All maintained an excellent record for low acidity and cleanliness. Then, for reasons not connected with the oil, the No. 3 turbine (extreme right in the picture) was filled with a conventional oil. And troubles started popping. Bearing temperatures rose. Sludge clogged oil screens. Oil had to be centrifuged continuously.

Another turbine was tried. When the troubles continued, it was thought that some mechanical difficulty in the turbine might be the cause. At the yearly overhaul period, No. 3 turbine was put back on Nonpareil, and turbine No. 1 was filled with a new batch of the conventional oil. The troubles switched over to No. 1. Bearings overheated; screens clogged and had to be cleaned every 60 days.

Back to normal. In the meantime, turbine No. 2 which had operated continuously, and No. 3 which had been refilled with Nonpareil, were giving no trouble. Acidity was low, and screens and coolers were cleaned only at the yearly inspection period. That was enough evidence for this operator. Nonpareil Turbine Oil is again in all three units.





Acidity control in Nonpareil. The low acidity of Nonpareil in the three turbines, as shown by the figures above, is obtained by the use of a *patented* inhibitor which is added to a highly refined oil from which the asphaltene-forming hydrocarbons have been removed. This also accounts for the unusually clean operation secured with Nonpareil. Its neutralization number is *guaranteed*, in writing, not to exceed the low limit of 0.15 mg.KOH/gm. for the life of your turbine.

COMPARISON OF SERVICE REQUIREMENTS BETWEEN NONPAREIL AND COMPETITIVE OIL

Noted during the period when turbine No. 1 was operating on a competitive oil and turbine No. 2 was operating on Nonpareil.

	Nonpareil	Other Oil
Oil Centrifuged . .	Every 30 days	Continuously
Screens cleaned . .	Yearly	Every 60 days
Oil replacements .	None	Yearly
Bearing temp. . .	140°—145°	160°—165°

Get all the facts. A Standard Lubrication Engineer can tell you many other operating advantages of this patented type of turbine oil. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska, at Omaha.

★ ★

NONPAREIL TURBINE OIL

★ ★

OIL IS AMMUNITION . . . USE IT WISELY

STANDARD OIL COMPANY (INDIANA)

★ LUBRICATION ENGINEERING

Mr. Kiessling received an A.B. degree from the University of Wisconsin in 1923, an A.M. in 1925 from the same institution, and a Ph.D. in 1927 from the Brookings Graduate School. He will be regularly stationed at the Washington office of the Institute.

Mr. Terborgh, the new Research Director, was senior economist with the Federal Reserve Board prior to his appointment as M.A.P.I. secretary in July, 1941. He is a specialist in the economics of the capital goods industries. As research director he will have charge of the study and educational activities of the Institute.

The Institute has recently appointed an Economic Policy Committee to collaborate with the staff on research and educational work. The membership of this Committee will be announced at an early date.

New Officers of L. J. Wing Mfg. Co.

Harry S. Wheller

L. J. WING MFG. Co., New York, N. Y., at a recent meeting of the Board of Directors, elected Harry S. Wheller president and general manager. Mr. Wheller, who has been vice-president since 1917, succeeds the late Alfred E. Seelig as head of the company, which was organized in 1883 and operates three plants in Newark, N. J. Mr. Wheller, who has been with the Wing company for over 35 yr., is responsible for the development of the light weight unit heater for industrial plants now in universal use.

Other officers elected were Walter W. Wilson, who has been with the company over 30 yr. as vice-president and treasurer, and Charles H. Smith, who has been with the company for 20 yr. as secretary.

Babcock & Wilcox Changes

THE FOLLOWING changes in personnel have recently been announced by The Babcock & Wilcox Tube Co. of Beaver Falls, Pa.: Leon E. Jeanneret, formerly assistant general sales manager, has been appointed manager of sales of the Welded Tube Div. with headquarters at Alliance, Ohio. Edward A. Livingstone, general sales manager at Beaver Falls will also be general sales manager of the Welded Tube Division. William J. Thomas, manager of mechanical tube sales, Beaver Falls, has been appointed assistant general sales manager. Mr. Thomas was formerly with the process equipment division of The Babcock & Wilcox Co. at Barberton, Ohio.

Westinghouse Treasury Manager

HARRY D. BYERS has recently been named treasury manager for the Pacific Coast District, Westinghouse Elec. & Mfg. Co. according to Charles A. Dostal, Pacific Coast district manager.

Veteran of nearly 20 yr. service with

RUN YOUR UNDERGROUND STEAM AND HOT WATER LINES IN

ADSCO BANNON TILE CONDUIT

The metal that would be required if all underground steam and hot water lines installed this year were run in metal conduit, would build a surprising number of tanks and guns.

This is why ADSCO-Bannon Tile Conduit is America's No. 1 wartime conduit.

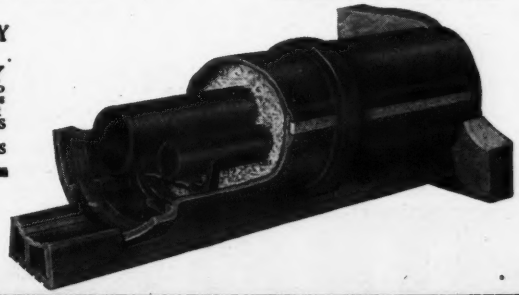
With the exception of a very small amount of metal used in pipe supports and rollers, ADSCO-Bannon Conduit is made of non-critical materials — Vitrified Clay Tile — fiberglas insulation.

Also, in ADSCO-Bannon Tile Conduit, a specially designed tile base drain provides adequate drainage for the underground lines. This prevents flooding of the conduit, thereby maintaining its thermal efficiency. Easily installed with a minimum of labor — makes a permanent installation.

Submit details of proposed installation for prompt quotation or write for illustrated bulletin No. 35-67E.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
MAKING "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 60 YEARS

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS



BASE DRAIN .... PREVENTS WATER SEEPAGE FROM FLOODING CONDUIT

FULLER ROTARY COMPRESSORS AND VACUUM PUMPS

SIMPLICITY OF DESIGN . . . AN OUTSTANDING FEATURE

The fewer moving or wearing parts that make up any piece of equipment, the more continuous service at the lowest operating cost. Fuller Rotary Compressors and Vacuum Pumps are an outstanding example of simplicity of design . . . only three moving parts: rotor, bearings, blades.

Ruggedly constructed, they will withstand long, continuous service and, after severe, gruelling operating periods, if inspection and check-up is desired, the machine design permits doing this easily and with a minimum loss of time.

Shut-downs are costly . . . lost time can never be recovered . . . install Fullers for day in and day out, continuous service.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1144 Marquette Bldg.
San Francisco: 421 Chancery Bldg.

C-72

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

Westinghouse, Mr. Byers will make his headquarters at San Francisco where he has served for the past 4 yr. as treasury department representative. He will have charge of departmental activities in an area comprising all or parts of 10 western states, Alaska and Hawaii. The new district treasury manager joined Westinghouse in 1923 as a clerk in the general engineering department, East Pittsburgh, Pa., and the treasury department late in 1928, and was transferred to San Francisco in 1939.

MANUFACTURERS' NEWS

ARMY-NAVY "E" AWARDS

Elliott Co.
Jeannette, Pa.
East Springfield, Mass., plant
Westinghouse Elec. & Mfg. Co.
The Austin Co.
Seattle, Wash.
The Carteret, N. J. plant*
Foster Wheeler Corp.
Refractories Division, Augusta Works
The Babcock & Wilcox Co.
Cummins Engine Co.
Columbus, Ind.
Irving Subway Grating Co., Inc.
Long Island City, N. Y.
Caterpillar Tractor Co.
Peoria, Ill.
S. F. Bowser & Co., Inc.*
Ft. Wayne, Ind.

*Added star for sustained high achievement in production of war equipment.

The Philip Carey Mfg. Co., Cincinnati, Ohio, recently acquired 35 acres in Perth Amboy, N. J., which will serve to expand the former Pardee Tile Works plant acquired by the Carey company in 1941.

American Engineering Co., Philadelphia, Pa., announces the appointment of the American Equipment Co., 5928 Second Blvd., Detroit, Mich., as its representative for Hele-Shaw pumps in the state of Michigan.

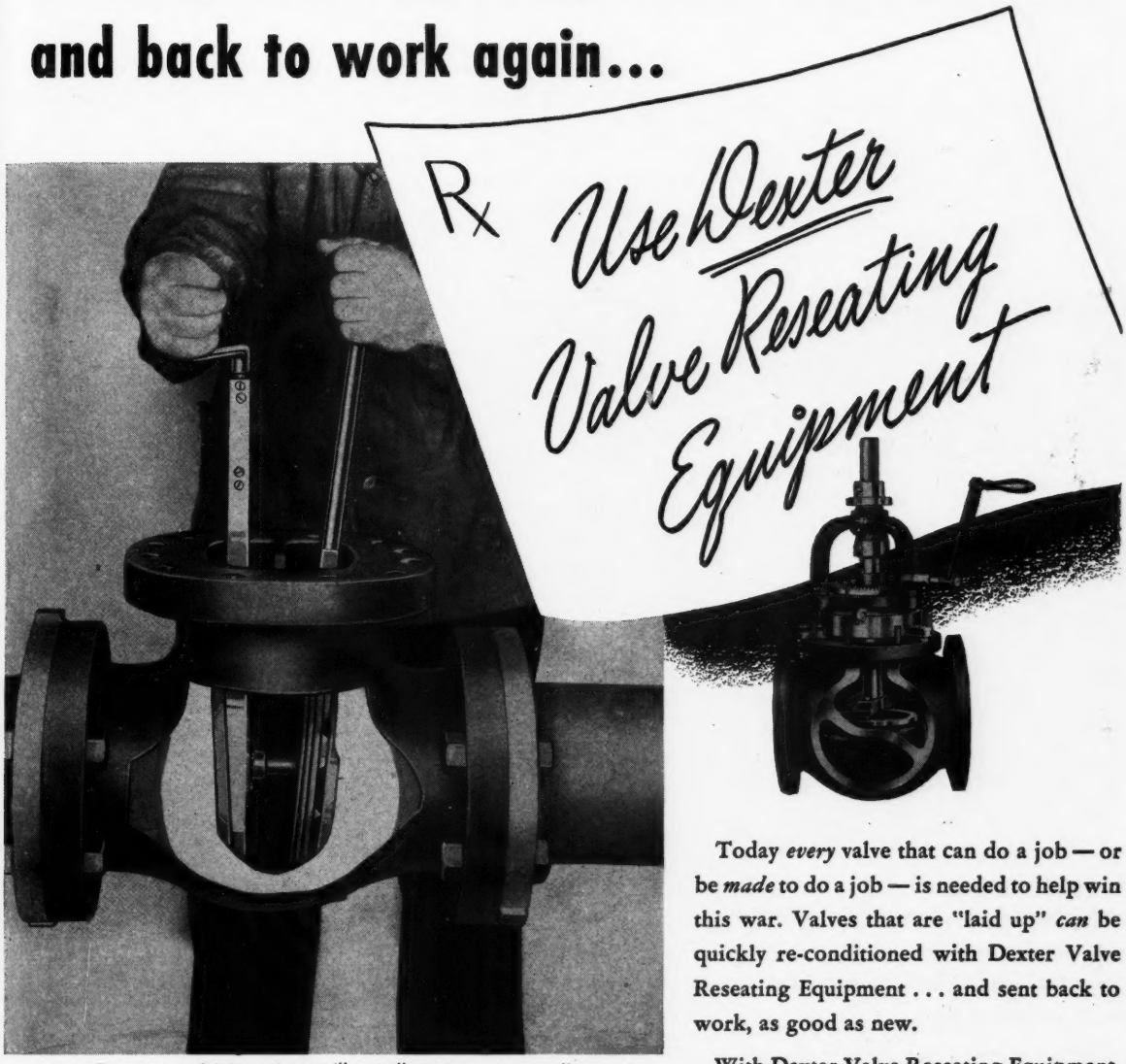
New G-E Turbine Factory at Syracuse

NINE MONTHS from the day General Electric laid plans for its new plant at Syracuse, N. Y., the first completed turbine generator was on final test and ready for shipment to some shipyard for installation on one of the government's new destroyers.

The building, second largest of all General Electric factories and covering a plot of more than 600,000 sq. ft., was finished well ahead of schedule. It is now operating on three shifts, seven days a week and when in full production will turn out these complete electric power plants for warships at the rate of better than one a day.

Plans were started on this factory the second week in March, the first steel work was erected two months later and the plant started operation September 16. Three months later the first unit was complete. The entire plant will be devoted to making only one size and type power plant.

Prescription for getting sick valves WELL... and back to work again...



Capacities: Globe valves, ¼" to 14"; Gate valves, 1½" to 48"; Pump valves, 1½" to 15".

Dexter
VALVE RESEATING EQUIPMENT

Today *every* valve that can do a job — or be *made* to do a job — is needed to help win this war. Valves that are "laid up" *can* be quickly re-conditioned with Dexter Valve Reseating Equipment . . . and sent back to work, as good as new.

With Dexter Valve Reseating Equipment, any mechanic can reseat any make of valve regardless of seat material whether it is made of monel, stainless, stellite, brass, or bronze. Very often the job can be done without removing valves from the line. In any case, when the job is done, seat and gate or disc become pressure tight.

Dexter Valve Reseating Equipment pays for itself *quickly*, often within a few months. Write now for complete information.

THE LEAVITT MACHINE CO., 403 EAST RIVER ST., ORANGE, MASS.

NEWS FROM THE FIELD

The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., will celebrate, this year, the fiftieth year of its founding as the Manhattan Rubber Mfg. Co.

The original company was incorporated Oct. 28, 1893. Among the incorporators were Frank C. Jones, W. W. Dashiell, Arthur F. Townsend, Peter Reid, Samuel J. Watson and George Woffenden.

At the first meeting of the incorporators Mr. Watson, Mr. Woffenden, Mr. Dashiell, Mr. Jones and Col. Townsend were elected to the board of directors. Officers elected were: Mr. Jones, president; and Col. Townsend, secretary and treasurer.

War expenditures by the United States Government totaled $6,254,000,000 in January. This was $129,000,000, or 2.1 per cent higher than in December and 185 per cent greater than in January, 1942.

The average daily rate of expenditure in January was $240,500,000, compared with $235,600,000 in December. The daily rate is based on the 26 days in January and December on which checks were cleared by the Treasury. In January, 1942, $81,200,000 were spent daily for war purposes.

The figures cover expenditures both by the Treasury and by the Reconstruction Finance Corp. and its subsidiaries.

John James on February 1 started new duties with the Iron Fireman Mfg. Co., Cleveland, Ohio, after 7 yr. service as Technical Secretary of the American Society of Heating and Ventilating Engineers, New York, N. Y. Mr. James' responsibilities with the Society since 1935 have included the preparation of the technical data for the annual edition of The Guide, the correlation and administration of the cooperative research program of the A.S.H.V.E., and work with code and technical committees.

The American Society of Tool Engineers will hold its annual national meeting in Milwaukee, Wis., March 25 to 27, inclusive, and a Machine and Tool Progress exhibition will be held in connection with it. The technical papers are expected to include symposia on such subjects as women in machine shops, increasing tool life, machining national emergency steels, tool engineering horizons and the like.

Midwest Power Conference April 8-9 at Chicago

THE PRELIMINARY program for the Midwest Power Conference to be held Thursday and Friday, April 8 and 9, 1943, at the Palmer House, Chicago, Ill., has been announced. General subjects for discussion will be central station practice, electrical distribution, Diesel power, fuels and combustion, industrial power plants and their protection and maintenance. Arrangements are being made by the director of the conference, Stanton E. Winston, professor of mechanical engineering, Illinois Institute of Technology, Chicago, from whom full details may be obtained. The Engineers' Society of Milwaukee has joined the group of midwestern engineering colleges and engineering societies sponsoring the conference.

Shipping Administration Seeks Engineers

THE AMERICAN MERCHANT MARINE is issuing a call for the return of seagoing manpower ashore to serve on merchant ships delivering equipment to the fighting forces in the foreign countries. A special campaign is being conducted in eight mid-western states to bring back to sea engineers who may now be working ashore in non-essential occupations. The United States Employment Service and all engineer organizations have been asked to help locate men with original Marine licenses. In addition, special courses have been developed by the Training Division of W.S.A. for refreshing men whose licenses have expired, for those whose licenses are limited and even for stationary engineers without previous sea experience.

Basic wages for all men at sea today are reported to be 25 per cent higher than they have ever previously been in the history of the Merchant Marine; third assistants getting from $165 to $224 per month, second assistants $180 to $253, and first assistants $200 to $316 with additional payment in all brackets for overtime and bonuses which bring the earnings up as high as $470 to $610 in some services.

EVERY WILSON TUBE CLEANER CAN BE PUT TO WORK 168 HOURS A WEEK

Unlike a human being, Wilson Tube Cleaners do not need rest. They can work hour after hour without stopping—they never tire. It is all the same to them whether they work 168 minutes or 168 hours a week. They can do this week after week and year after year. This is because they have *extra ruggedness, extra speed, extra power* and *extra efficiency* designed and built into them. Put one to work and see for yourself.

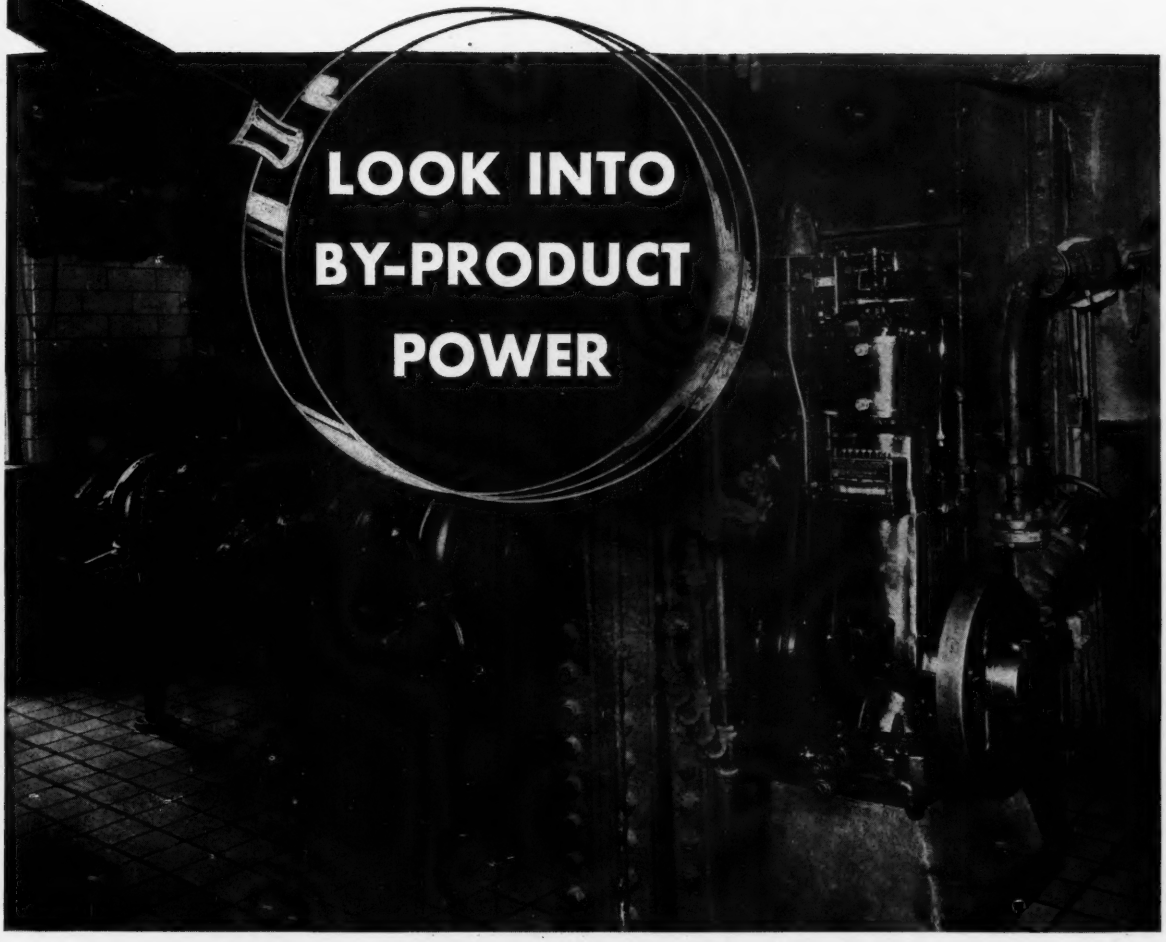
There is a Wilson Tube Cleaner, cutter head, brush or other accessory for cleaning straight or curved ferrous or non-ferrous tubes of large or small diameter *faster, better* and *more economically* and saving time, tubes and trouble.

Write for the name of our representative nearest to you or send for a copy of our NEW forty-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

INVEST IN AMERICA! BUY WAR BONDS AND STAMPS!

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
THE WILSON BUILDING
21-11 44TH AVE. LONG ISLAND CITY, N.Y.

Looking for More Power?



SOMETIMES it's the simple things that are overlooked . . . for example, the simple expedient of putting steam from the boiler through a steam engine to extract its power before sending it on for processing or heating.

Hundreds of plants did this very thing, and produced a very favorable effect on their power cost structure.

This power is called By-Product Power because it is secondary to the main function of the steam.

You can get By-Product Power in the driving of almost any piece of equipment—stoker, fan, blower, generator, compressor, pump or dryer. Send for Bulletin 101 which discusses this subject in detail.

TROY ENGINE & MACHINE CO.

Established 1870

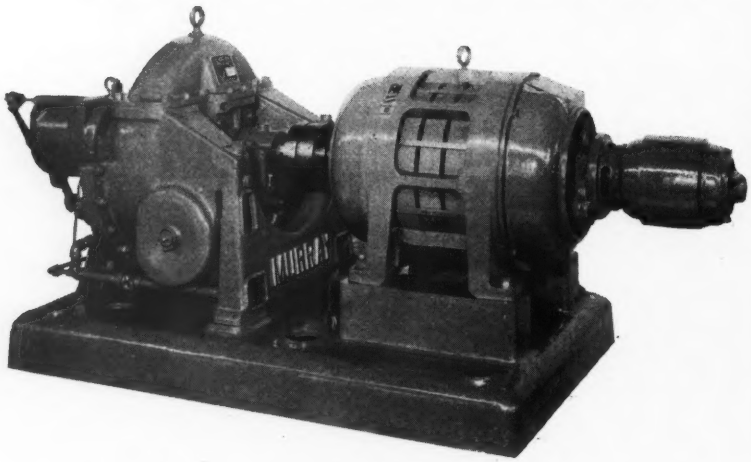
850 Railroad Avenue **Troy, Pa.**

3-TEM-1

MURRAY

• TYPE "U" •

Mechanical Drive Turbines



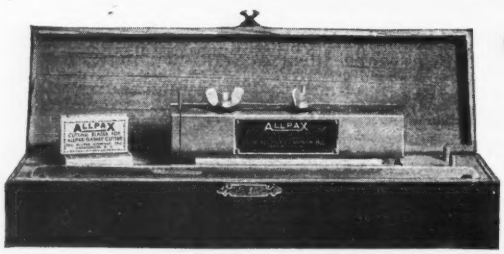
MURRAY Type "U" Mechanical Drive Turbines are adaptable to a variety of drives. View shows Type "U" turbine directly connected to a 20 K.W. alternating current generator operating at 1800 R.P.M. The unit is installed in a large oil refinery in Venezuela where the turbine supplies exhaust steam for process requirements. . . . For details of construction and performance of Murray Type "U" Turbines, write for Bulletin T-118.

BOILERS TURBINES ENGINES

MURRAY IRON WORKS COMPANY

INCORPORATED 1870

BURLINGTON IOWA



Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere *Mamaroneck, N. Y.*

Engineers interested in this type of work are invited to write to Marshall Dimock, Director Recruitment and Manning Organization, War Shipping Administration, Washington, D. C., or make inquiry at the nearest U. S. Employment Service office.

Detroit Edison Budget For 1943

THE DETROIT EDISON Co., Detroit, Mich., is arranging a fund of about $5,000,000 for expansion, improvements and maintenance of plants and system in 1943. Work will include transmission and distributing lines, power substation extension and betterments, service connections and miscellaneous operating facilities. There is no provision in the amount noted for central station expansion. The company has had work in progress on extensions in steam-electric generating station at Marysville, Mich., to include installation of a new 75,000-kw., turbine-generator unit and accessories. This program was discontinued a number of weeks ago by order of WPB, and is now being held in abeyance, with work to proceed as soon as the stop order has been lifted. Should this be before the end of the present year, about $3,000,000 will be added to the 1943 budget for completion of this project.

Considerable increase in industrial power supply will be in evidence this year; the company will furnish service at the new magnesium plant of the Dow Chemical Co., now scheduled for completion about April, which will have a connected load of 90 000-kw., operating under an electro-chemical process. Additional power requirements are expected, also, from the new Willow Run aircraft plant of Ford Motor Co. The company is making provision in the 1943 budget for an increase of 15,000 to 20,000 additional consumers, primarily of residential character, with service connections for this purpose, installation of meters and accessory equipment. At its steam-operated stations, it is estimated that 2,500,000 tons of coal will be used during the year. The 1943 appropriation of $5,000,000 compares with an appropriation of $12,000,000 a year ago.

Municipal Power for New York

A BILL has been introduced in the State Legislature, Albany, N. Y., to create a municipal power authority for New York City, the proposal to be placed before voters at the forthcoming November election for ratification or rejection. The measure provides for a power authority of not more than seven members, appointed by the mayor. The authority would acquire and operate plants, distribution lines and other facilities, furnishing service to public and private consumers. It would collect charges, it is set forth, sufficient to pay interest and principal on debts and expenses, including retirement reserve.

North American Co. Expansion Budget

THE NORTH AMERICAN Co., New York, N. Y., operating a number of light and power companies in different parts of the country, is providing a fund of about $25,000,000 for expansion, improvements and maintenance in various properties

Announcing

A Dust Collector Made of Non-Critical Materials

Here is the most revolutionary and important dust collector news of the year! A dust collector made entirely of non-critical materials, which can be delivered now without a priority.

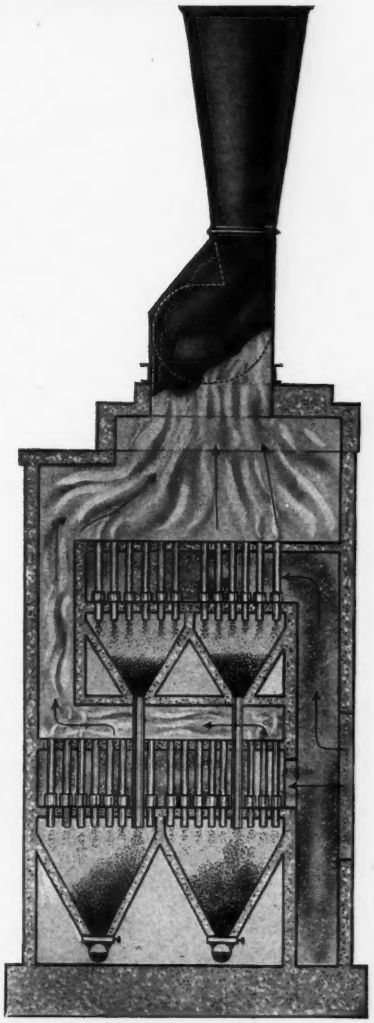
Instead of using steel for the tubes of this new Thermix Ceramic Dust Collector, they are made of tough fire clay. These tubes are sufficiently thick and rugged to be proof against fracture and breakage from normal handling and temperature changes, and they can be replaced with standard shapes if necessary. They weigh no more than steel tubes.

The Thermix Ceramic Dust Collector possesses all the features that have made Thermix Dust Collectors famous, for more than 17 years, for their high dust collecting efficiency and long trouble-free and economical operation. It assures the collection of practically all fine pulverized fuel fly-ash except a small percentage of the ultra-fine, low-carbon dust, which is the least objectionable.

The first cost is moderate and it costs practically nothing for maintenance. Can be easily installed in small space in new or old plants . . . and will even operate satisfactorily outside of a plant without a protecting structure.

Thermix Steel-Tube Dust Collectors are now in operation in connection with more than 40,000,000 lbs. of steam capacity per hour.

Write for full particulars, or mail the coupon.



PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities

Thermix Ceramic DUST COLLECTOR

PRAT-DANIEL CORP.
86 S. Water St., Port Chester, N. Y.

Without obligation on our part you may send details about the Thermix Ceramic Dust Collector.

NAME .....

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CITY..... **STATE**.....

$2500 . . $5000 . . $7500? Whatever the amount may be, the eyesight of your boiler room operators is too valuable to be endangered by shattering of ordinary gauge glass under today's pressing load conditions.

Resolve now to stop taking chances. Fit all water columns with SONDERGLASS, either *clear* or *reflecting* type. Its double-strength construction brings added safety to boiler room operation. And it resists clouding or discoloration no matter how long it is in service.

Genuine SONDERGLASS, which thousands of engineers know as "The Unbreakable Gauge Glass" may be ordered from your steam supply man or directly from us.

Tested for SHOCK Resistance!

In repeated tests SONDERGLASSES have been dipped in hot oil 450 deg. F., then quickly plunged in cold water without breaking.

A. W. CHESTERTON COMPANY
64 India Street, Boston, Mass.
Distributors In Principal Cities

SONDERGLASS

OUR MEN NEED ★ BOOKS ★

SEND ALL YOU CAN SPARE

That book you've enjoyed—pass it along to a man in uniform. Leave it at the nearest collection center or public library for the 1943 VICTORY BOOK CAMPAIGN.

during 1943. The work will include completion of certain extensions in generating stations now under way, transmission and distributing lines, power substations and other field structures, with service connections and facilities. The principal power properties of the company include the Union Electric Co. of Missouri; Wisconsin Electric Power Co., Milwaukee, and subsidiaries; Cleveland Electric Illuminating Co., Cleveland, Ohio; and the Potomac Edison Co., Washington, D. C. The last noted company has work in progress on expansion at its Buzzard Point steam-electric power station, with installation of additional equipment for increased capacity.

A.S.H.V.E. Holds 49th Annual Meeting

With a registration of 380, the 49th Annual Meeting of the American Society of Heating and Ventilating Engineers opened Monday, January 25, 1943, at the Hotel Gibson, Cincinnati, O., with 1st vice-president M. F. Blankin presiding in the enforced absence of Prof. E. O. Eastwood, Seattle, Wash., president of the society.

Lt. Comdr. T. H. Urdahl presented his paper concerning warship ventilating, heating and air conditioning. W. B. Van Arsdel gave an interesting description of the engineering problems encountered in the new vegetable dehydration industry.

At a get-together luncheon with members of the Engineers' Club of Cincinnati, Dr. B. M. Woods, member of the Council and professor of mechanical engineering, University of California, Berkeley, spoke on The Manpower Problem in Engineering.

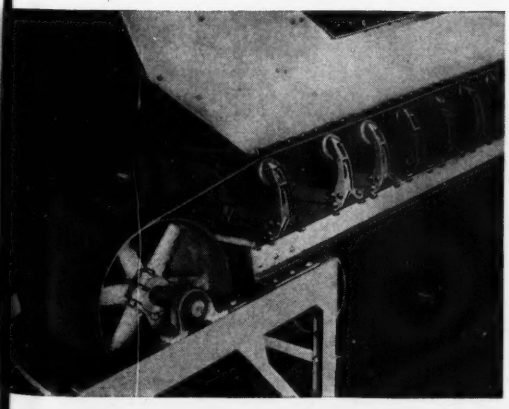
On Monday afternoon, Prof. D. W. Nelson, University of Wisconsin, co-author with G. E. Smedberg, presented the cooperative research paper on the performance of side outlets on horizontal ducts. R. E. Biller, Washington, D. C., gave a paper prepared by himself, Major L. C. McCabe and S. Konzo, on the Army fuel consumption studies for 1941-42. In an interesting presentation, R. C. Corss, Chicago, described the performance characteristics of a coal-fired space heater, and explained some of the test results which had been obtained in the laboratory. W. S. Harris, who prepared a paper with Professors A. P. Kratz and M. K. Fahnestock, described the operation of the Research Home with reduced room temperature at night.

The Tellers of Election reported the following results: president, M. F. Blankin, Philadelphia, Pa.; first vice-president, S. H. Downs, Kalamazoo, Mich.; second vice-president, C.-E. A. Winslow, New Haven, Conn.; treasurer, E. K. Campbell, Kansas City, Mo. Members of Council elected for three-year term as follows: J. F. Collins, Jr., Pittsburgh, Pa.; Prof. James Holt, Cambridge, Mass.; E. N. McDonnell, Chicago; and Lt. Comdr. T. H. Urdahl, Washington, D. C. Members of Committee on Research for three-year term are as follows: Dr. H. J. Rose, New York, N. Y.; L. P. Saunders, Lockport, N. Y.; Prof. L. E. Seeley, New Haven, Conn.; Comdr. A. E. Stacey, Jr.; and C. Tasker, Toronto, Canada.

On the Tuesday morning program, L. R. Vianey, Massachusetts Institute of Technology, and co-author with Prof. G. B. Wilkes, presented the paper on the effect of convection in ceiling

COAL FOR THE FIRES OF VICTORY

Efficiently Handled by an S-A Conveyor Installation



● The conversion of a power plant to coal often involves some questions of space, or handling, or storage or ash removal, which would *make or break the whole job.* The answer is: See S-A.

Stephens-Adamson has equipped and co-operated in the engineering of countless installations for unloading, conveying, storing and reclaiming coal—distributing it finally to the bunkers—all with minimum supervision, manpower and delay.

In the example illustrated here, one conveyor system elevates coal from boats or cars and distributes it to bunkers for immediate use, or diverts it by boom conveyor to a great storage pile. An additional tunnel conveyor system beneath the pile, draws on it to fill the bunkers as needed.

Today's conditions thoroughly prove how far-seeing such engineering was.

STEPHENS-ADAMSON MFG. CO.

515 Ridgeway Avenue, Aurora, Illinois ● Los Angeles, Calif. ● Belleville, Ontario

STEPHEN S-A DAMSON MFG. CO.

Chains and Sprockets · Belt Conveyors · Bucket Elevators · Crushers
Bin Gates · Pan Conveyors · SealMaster · Feeders · Screens
Speed Reducers · Redler Conveyors · Ball Bearings · Skip-Hoists · Winches and Car Pullers

515 Ridgeway Avenue, Aurora, Illinois

An Air Raid Warden for STEAM-USING UNITS

The Anderson Thermal Air Eliminator on a Super-Silvertop Steam Trap is an air raid warden whose job is to remove air from any type of steam-using device that needs instant heat. It is "on duty" the minute steam is turned on. Located on the side of the bucket, the snap-action air eliminator is wide open and the pressure of that steam forces the air out the exhaust in an instant. Then the eliminator disc snaps shut over the exhaust preventing steam loss. With the air removed, hot dry steam is supplied immediately and heating begins at once. Once the air is removed, Super-Silvertop keeps the unit free of condensate and entrained air for the balance of the heating cycle. Write for the book "How To Choose A Steam Trap" that explains Snap-Action Thermal Air Elimination.

THE V. D. ANDERSON CO.
1939 W. 96th Street • Cleveland, Ohio

Super-Silvertop
STEAM TRAPS

Be 100% with your 10%

Buy WAR BONDS

Qualify for the 10 Per Cent Club by investing 10% of your earnings in War Bonds for Victory. Show Uncle Sam you're glad you're an American and are willing to *invest* your money to stay one!

10%

insulation. Prof. C. O. Mackey, Cornell University, and co-author with L. T. Wright, Jr., gave the paper on summer comfort factors as influenced by the thermal properties of building materials. He was followed by Prof. F. E. Giesecke, professor emeritus at A. & M. College of Texas, who presented the results of his recent investigation on friction heads due to flow in copper, brass and other smooth pipes. In the absence of the author, L. V. Teesdale, Madison, Wis., John James, technical secretary of the Society presented the paper on the comparative resistance to vapor transmission of various building materials.

On Tuesday afternoon the Report of the Research Committee was given by F. C. McIntosh, chairman, and he summarized the reports of the 23 Technical Advisory Committees which had been serving during the year.

Lt. Comdr. F. C. Houghton, U.S.N.R., presented the paper which he prepared with Carl Gutberlet and Dr. M. B. Ferderber, on the physiological reactions applicable to workers in hot industries.

The concluding feature of the technical meeting was a panel discussion on the subject of how to keep fit in cold homes, which was conducted by C.-E. A. Winslow, the newly elected second vice-president of the Society.

The annual banquet was held in the roof garden at the Hotel Gibson on Tuesday evening with the Hon. Russell Wilson, former mayor of Cincinnati as toastmaster. The speaker of the evening was Col. William N. Carey, Corps of Engineers and Chief Engineer for the Federal Works Agency, Washington, D. C. He briefly reviewed the achievements in the past year in creating a large fighting force and the more cheerful viewpoint than was apparent compared to a year ago. He indicated that encouragement and confidence must be given in business through some established policy for the post war period and discussed the kind of planning we need. He summed up by saying that, if by planning, a war over foreign tyrants can be won, it is also possible by planning to win the war against the tyrannies of depression, want and misery at home.

President-elect M. F. Blankin presented the Life Membership Certificates to Dr. W. H. Carrier and Perry West.

Washington Award to Dean A. A. Potter

ANDREY ABRAHAM POTTER, Dean of Engineering Schools and Director, Engineering Experiment Station, Purdue University, Lafayette, Ind., received the Washington Award on Feb. 24, 1943, at a dinner held by the WSE in conjunction with the A.S.M.E., A.S.C.E., A.I.M.&M.E. and A.I.E.E. at the Union League Club, Chicago.

E. Gordon Fox, chairman of the Award Commission, reviewed the history of the award, which is conferred by engineers upon a brother engineer for accomplishments that pre-eminently promote the happiness, comfort and well-being of humanity.

Dean Potter, in accepting the Award, addressed the meeting on The American Engineer and the War Effort. He reviewed first the outstanding accomplishments of engineers in speeding up the

This Year Rubber Is Tapped from Test Tubes

Synthetic Rubber Already Is Working for Users of Mechanical Rubber Goods

War production is up threefold. But the vital rubber stock pile is dwindling fast. This is the year of crisis in rubber.

There is only one solution . . . the production of synthetic rubber in steadily increasing tonnages . . . synthetic rubber to take over jobs once handled by natural rubber . . . to perform new tasks, serve in new applications created by wartime need.

One of the first synthetic rubber plants in the Government's program was built and is being operated by United States Rubber Company . . . another soon will be in production.

Our engineers have been working with synthetic rubber since 1921. During this period they have learned that no one synthetic should be used for all types of mechanical rubber goods. They have found where and how synthetic is superior to natural rubber, where it is equally as good, where it falls short. They know what uses each of the five basic commercial types of synthetic rubber is best suited for — Neoprene, Buna-S, Buna-N, Butyl, or Thiokol—and how to compound the specific synthetic rubber for the specific task. U. S. Rubber has used all five types and knows which one to select for the performance required.

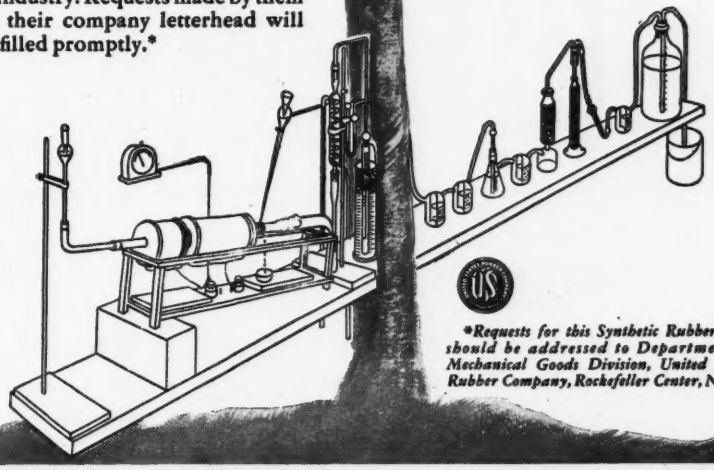
Information based on the results of vast experiments and practical applications of synthetic rubber has been incorporated in a new comprehensive book, *The Five Commercial Types of Synthetic Rubber.*

This informative book traces the history of synthetic rubber from the earliest experiments of Michael Faraday to the present. It discusses each of the basic types of synthetic rubber, tells where it has been used successfully in United States Rubber Company products, and compares its properties with natural rubber. It tells how synthetic rubber is made. It is a detailed answer to the most vital question of the day.

We feel that *The Five Commercial Types of Synthetic Rubber* is a publication of real importance to men of industry. Requests made by them on their company letterhead will be filled promptly.*

The successful use of synthetic rubber in mechanical rubber goods and the insurance of fully dependable service depend largely upon the skill of the manufacturer and compounder. Each of the five basic commercial types of synthetic permits a myriad of variations.

The United States Rubber Company has been developing and improving rubber products for one hundred years. Today, the same vast resources for research and development that resulted in some of the most spectacular achievements in the rubber industry are being devoted to the problem of synthetic rubber. A great backlog of knowledge already has been built. More is being constantly added.



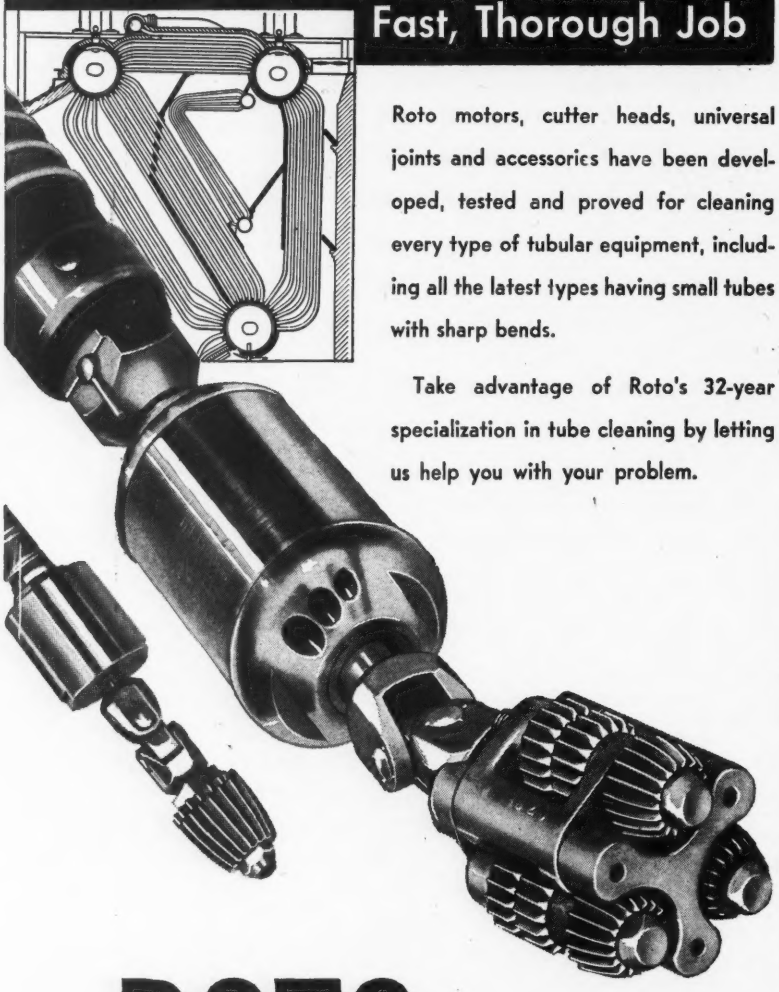
**Requests for this Synthetic Rubber Book should be addressed to Department 7 Mechanical Goods Division, United States Rubber Company, Rockefeller Center, N. Y. C.*

UNITED STATES RUBBER COMPANY

Mechanical Rubber Goods Division • Rockefeller Center • New York

In Canada, **Dominion Rubber Co., Ltd.**

Clean Tubes Give Greater Production for War..... Use ROTO for a Fast, Thorough Job



Roto motors, cutter heads, universal joints and accessories have been developed, tested and proved for cleaning every type of tubular equipment, including all the latest types having small tubes with sharp bends.

Take advantage of Roto's 32-year specialization in tube cleaning by letting us help you with your problem.

The ROTO Company

145 Sussex Ave., Newark, N. J.

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

nation's production for war 400 per cent in the last year, discussed the tremendous needs of both military forces and industry for engineers and the methods used and projected for training them. The engineer, he said, is held in the highest esteem by everybody connected with the war effort. But, he added, there is a tendency on the part of some to think that engineers and even technicians can be produced by "streamlined" courses. Engineers know that this is not so and must exert their influence to see that the training program is soundly conceived, for everything depends on its results. In closing, he discussed the relation of the Patent System to engineering and the welfare of the country.

Dean Potter was born in Russia, came to the U.S. at the age of 15, graduated from M.I.T. in 1903 and after 2 yr. in the Research Department of General Electric Co., became assistant professor of mechanical engineering at Kansas State College. He was made professor in 1910 and in 1913 was made dean and director of the engineering experiment station. He remained at Kansas until 1920, when he accepted his present position at Purdue.

OBITUARIES

Benjamin A. Keiley

BENJAMIN A. KEILEY, Chairman of the board of directors of the Power Transmission Council, Inc., New York City, died suddenly in Chicago, Ill., on February 17.

Mr. Keiley was president of the R. & J. Dick Co., Inc., Passaic, N. J., and the Barry Pulley Co., Muscatine, Ia., and also president of the Multiple V-Belt Drive Assn.

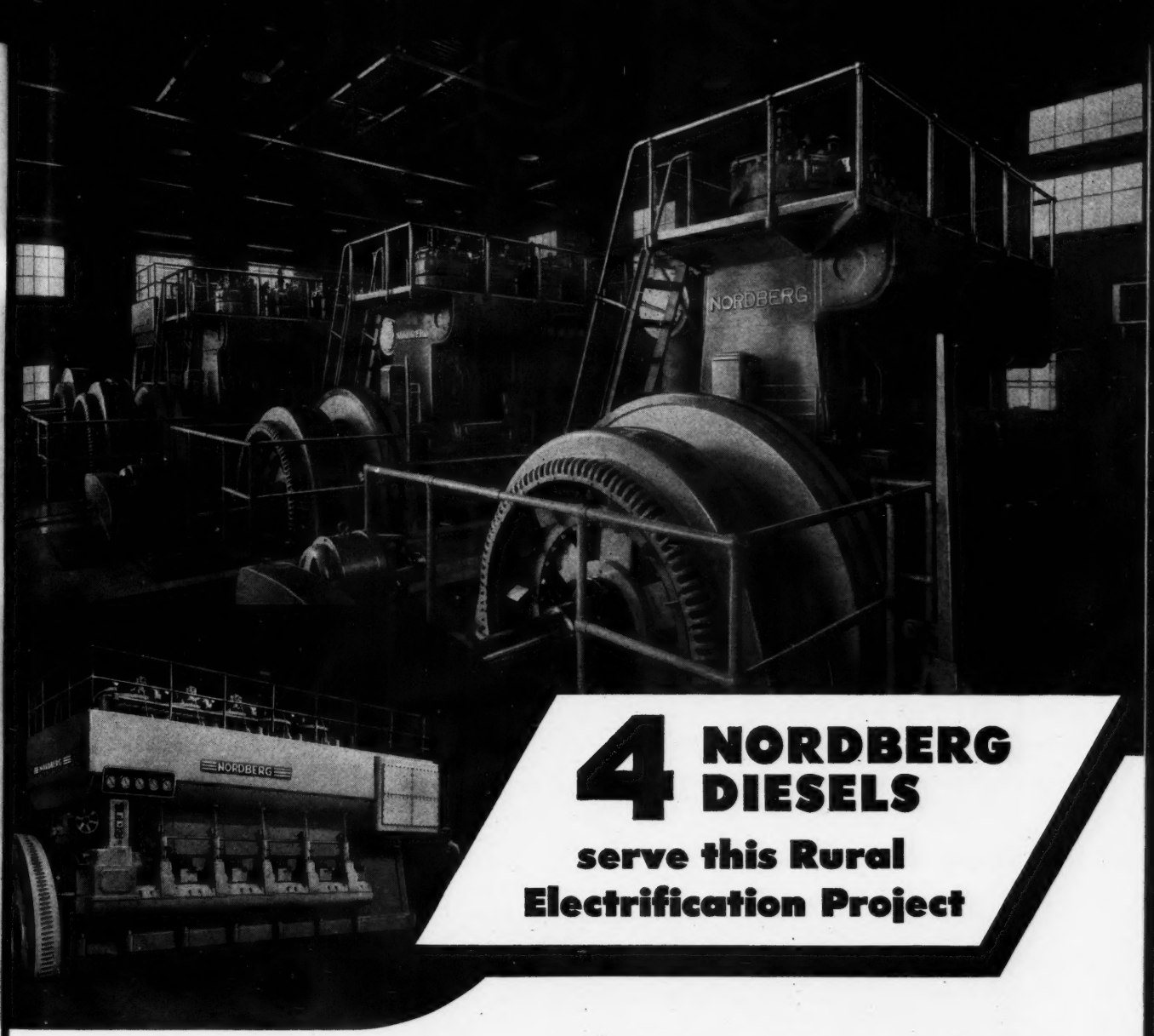
James Griswold Blunt

JAMES GRISWOLD BLUNT, 74, assistant to James E. Davenport, vice-president in charge of engineering of the American Locomotive Co., died in Schenectady, N. Y., on February 15.

Born April 7, 1868, at Cincinnatus, Cortland County, N. Y., Mr. Blunt was a graduate in mechanical engineering at the University of Michigan in 1894. For the following 3 yr. he was machinist for the Buda Co., Harvey, Ill.; draftsman for the Welland Iron Works, Welland, Ont.; draftsman for the Bucyrus Co. and the Industrial Works, Bay City, Mich.; and instructor in manual training in Pueblo, Colo., High School.

In 1897 he accepted a position as draftsman with the Brooks Locomotive Works, Dunkirk, N. Y. From 1899-1906 he was chief draftsman there. When the Brooks Locomotive Works was merged with other companies into the American Locomotive Co., Mr. Blunt then became engineer for the drafting department, holding this position until 1916 when he became mechanical engineer and in 1941 he was named assistant to the vice-president in charge of engineering. Many devices for meeting the high-speed requirements of railroads in recent years were designed and perfected by Mr. Blunt.

He was a member of the A.S.M.E. and served as honorary vice-chairman of the Schenectady Division in 1923. He was a past president of the Society of Engineers of Eastern New York.



4 NORDBERG DIESELS

serve this Rural Electrification Project

A large portion of the normal load is carried by a five cylinder, 2000 H.P. Nordberg Diesel as shown above, the largest and latest unit to be installed at the Reeve generating plant.

We are proud to fly the Navy "E" with the added star signifying that excellence in production has been maintained.

An unusually successful record has been established by the Federated Co-Operative Power Association, a rural electrification project serving a half dozen counties centered around its generating station at Reeve, Iowa. The performance of this plant and its rapid growth is evidence of its success. Service was started in 1935 with two Nordberg Diesels of 750 and 1000 H.P. In 1939 a 1500 H.P. unit was added and in 1941 the latest addition of a 2000 H.P. engine was made, the plant now totalling 5250 H.P., being among the larger all-Diesel generating stations in Iowa. That Nordberg Diesels were selected when units of greater capacity were needed is evidence of the satisfactory service given by previous installations.

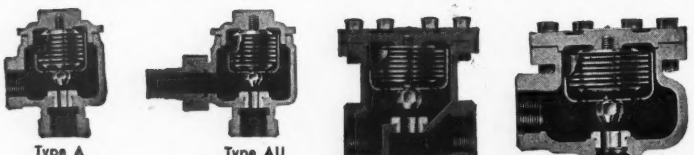
NORDBERG MFG. CO. • MILWAUKEE

NORDBERG

DIESEL ENGINES

NORDBERG MACHINERY

DON'T OVERLOOK THIS POSSIBILITY FOR INCREASED PRODUCTION



Type A Type AU Type B Type C

MANY REPORTS PROVE THAT THESE NICHOLSON INDUSTRIAL TRAPS BOOST EFFICIENCY OF HEATED UNITS AS MUCH AS 30% THRU BETTER CIRCULATION OF STEAM

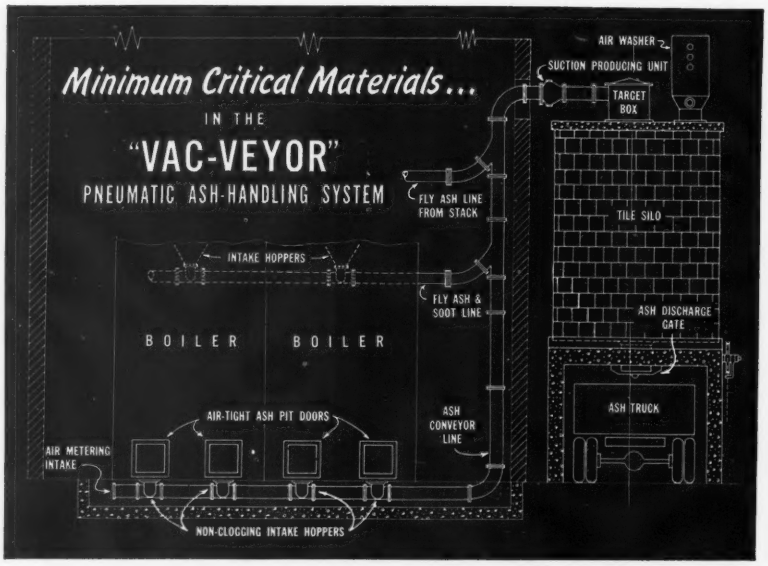
Two to six times greater discharge capacity. Quick automatic action. No air-binding . . . no dribbling . . . no freeze-ups . . . no water logging . . . no adjustment. Frequent intermittent discharge induces rapid heat transfer in water heaters, pipe coils, kettles, driers, unit heaters, etc. Four types; sizes ¼" to 2"; pressures to 300 lbs.

BULLETIN No. 242—W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON *Traps*

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS



Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

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MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

NEW ENGINEERING BOOKS

Electric Arc Welding Machine and Electrode Standards. Publication No. 42-81. Published by the National Electrical Manufacturers Assn., Engineering Dept., 155 E. 44th St., New York, N. Y. Price 75 ct.

This handbook, superseding Publication No. 36-37 on the same subject issued in 1936, constitutes a complete revision on standards for both a.c. and d.c. arc welders. The standards for electrodes have been segregated and to them has been added a table for two-color markings for heavy coated ferrous electrode identification.

Heat. 2nd Edition. By James M. Cork. Size 6 by 9 in; 294 p.; cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $3.50.

Since the publication of the first edition of this popular textbook, so many advances have been made in certain phases of the subject of heat that publication of a revised edition seemed advisable at this time. This new second edition contains many references to the work done in the fields of extremely low temperatures and temperature measurement and contains a complete discussion of the International Temperature Scale which has been generally adopted.

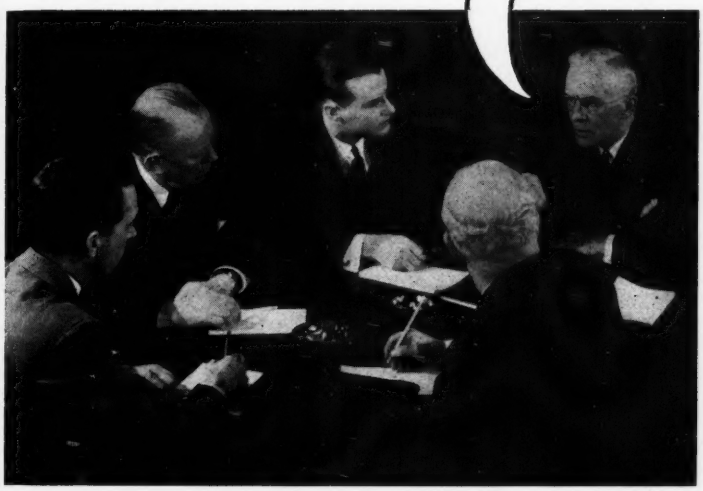
An effort has been made in this new edition to make the text adaptable to the student with less preparation by including somewhat more descriptive matter and by setting off in smaller type certain more difficult topics which may be omitted with no loss in continuity.

The book is divided into nine chapters under the following headings: Temperature and Its Measurement; Specific Heats; Thermal Expansion; Transfer of Heat-Conduction and Convection; Radiation; First Law of Thermodynamics; The State of Matter; Thermodynamics — Elementary; The Production of High and Low Temperature; and an Appendix consisting of nine tables and a list of Suggested Topics for Experimental Study. At the end of each chapter is a group of questions and problems for the student to work out.

Ripper's Heat Engines. Revised by A. T. J. Kersey. Size 5 by 7½ in., 337 p., cloth bound. Published by Longmans, Green and Co., Inc., 55 Fifth Ave., New York, N. Y. Price $1.60.

Because the steam turbine and internal combustion engine are rapidly taking the place of the reciprocating steam engine as the principal prime mover both in land and marine practice, a revised edition of this popular textbook was necessary. This new edition is brought up to date by the addition of new material and omission of obsolete and out of date material. Although it covers English practice primarily, it is applicable to American practice and its

"IF THE WAR ENDS THIS YEAR, OR NEXT, WILL WE BE READY TO MEET THE NEW CONDITIONS?"



Post-war competition will be keen. The plants which excel will be those which plan now to take advantage of savings which can be effected through modernization of coal burning equipment.

FUEL costs materially affect the cost of the final product in most industrial and utility plants. Post-war competition will be extremely keen in the industrial field. If the product you endeavor to market after the war is burdened with an item of excessive fuel costs, your company will be in a vulnerable position. If your old and new competitors have low fuel costs, they will enjoy a distinct advantage. Holding manufacturing and fuel costs to a minimum will then become a matter of vital importance and will frequently mark the difference between solvency and insolvency of a business.

If your plant has obsolete and unsuitable burning equipment which prohibits the use of the greatest value-giving coals, you should make plans *now* to modernize. Equipment manufacturers are now beginning to put their houses in order to handle plant modernization programs, so it is not too early to contact consulting engineers and manufacturers of stokers, pulverizers, furnaces and boilers and plan to modernize your plant so as to permit the use of coals which produce the lowest overall steam costs.

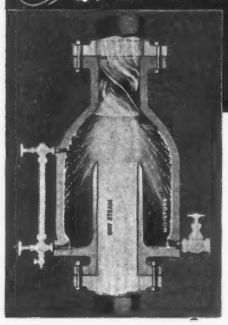
Consideration should be given to the fact that the preponderance of steam coals available today fall in the low fusion ash bracket, and that because of their abundance these offer the greatest fuel values. Good engineering and design insure complete satisfaction in the burning of these coals.

PICK FUEL FOR THE FUTURE AND FOR TODAY

Request a copy of the Brochure—Coal—which describes the Pittsburgh, the greatest coal seam in West Virginia, the Number One producing state.

COAL BUREAU, Upper Monongahela Valley Association
Peoples Building, Fairmont, West Virginia

Whirl the costly hazards out of your steam with Swartwout Separators



● You'll appreciate the *simple, sure* separating action of the *helico-centrifugal principle* used in Swartwout Separators. No slugs of water can slip by to ruin engine or turbine: no dirty oil or grease to spoil work in process. "It's the *whirl* that does the trick." Positive separating action without pressure loss. Adequate storage capacity. Occupy small space. Illustration shows vertical type. Swartwout Separators also are made in horizontal type, and for all pressures and all temperatures. . . . Write for Bulletin S-14-B.

THE SWARTWOUT COMPANY
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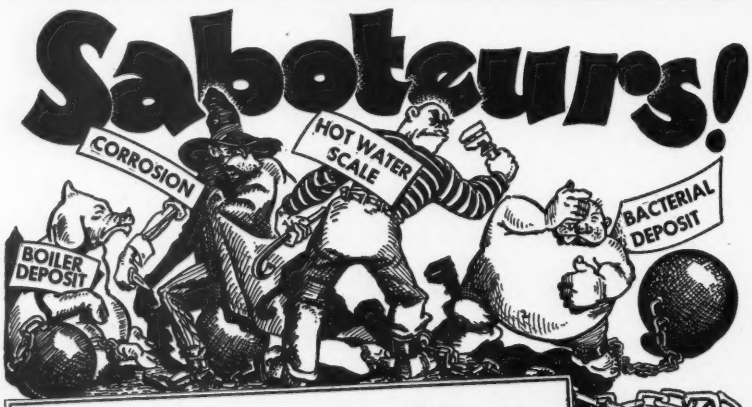
Over 5000 of the Swartwout Separator style shown below are in use.

SWARTWOUT EXHAUST HEAD

Operates on same principle as Separators. Removes oil and water without changing direct flow of steam. Causes no back pressure. Sizes 1 in. to 30 in. Write for Bulletin S-16-A.

Swartwout

Saboteurs!



By controlling scale, corrosion, and living organisms, Haering Glucosates definitely improve efficiency, increase production, reduce operating costs, and add years to the life of equipment. Our growth is due to the accomplishment of these results. A smoothly running plant with less outage and waste equipment requires less supervision and fewer men for operation.

If saboteurs in the form of scale, corrosion and algae are attacking your boilers, steam or water systems, feel free to call upon us. Our advisory service is offered without obligation to plant owners. We shall be glad to have one of our engineers call to survey your problems.

Write for "Organic Methods of Scale and Corrosion Control."

HAERING WATER CONTROL

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GENERAL OFFICES:
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clear explanation of essential principles and outline of their main applications meet the needs of a large number of students.

The book is divided into 20 chapters covering heat and all its phases, steam, steam engines, valves, gears, cranks, condensers and governors, locomotives, compound engines, boilers, fuels and combustion, steam turbines and internal combustion engines. In the back of the book are 16 pages of examples and their answers.

Asbestos Factbook. 16 pages. Published by Secretarial Service, 16th Floor, Inquirer Bldg., Philadelphia, Pa. Price 10 ct.

This asbestos booklet is a compact assembly of facts. It contains information on the origin, locations, uses, analyses and qualities of asbestos and should prove to be a handy booklet for anyone interested in asbestos.

Simplified Procedure for Selecting Capacities of Duct Systems for Gravity Warm-Air Heating Plants. By Alonzo P. Kratz and Seichi Konzo. Size 6 by 9 in., 49 p.; paper bound. Published as Circular Series No. 45 by the Engineering Experiment Station of the University of Illinois. Price 55 ct.

This is an analysis of the underlying principles of the Standard Gravity Code adopted in October, 1922, which introduced the first rational procedure for the design of gravity warm-air heating systems. The analysis was made incident to the investigation of warm-air furnaces and heating systems being conducted under the joint sponsorship of the Engineering Experiment Station and the National Warm-Air Heating and Air Conditioning Association and is conducted in the Department of Mechanical Engineering of the University of Illinois.

Tests of Riveted and Welded Joints in Low-Alloy Structural Steels. By Wilbur M. Milson, Walter H. Bruckner and Thomas H. McCrackin, Jr. Size 6 by 9 in., 76 p.; paper bound. Published as Bulletin Series No. 337 by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price 80 ct.

This is a report of an investigation conducted by the Engineering Experiment Station in cooperation with The American Bridge Co. to determine the properties of three low-alloy structural steels, furnished in accordance with A.S.T.M. Tentative Specifications A242-41T, and to determine the behavior of structural joints fabricated of these steels. These steels are designated as low-alloy A, low-alloy B, and low-alloy C. The plates and rivets of a riveted joint were of the same kind of steel in each instance.

Static tests, without supplementary fatigue tests, were made to determine the chemical composition and physical properties of the materials; the initial tension, tensile strength, hardness and shearing strength of driven rivets; the strength of plates without joints, of joints in plates fabricated by riveting, and of joints in plates fabricated by welding. Parallel tests were made of the three steels.

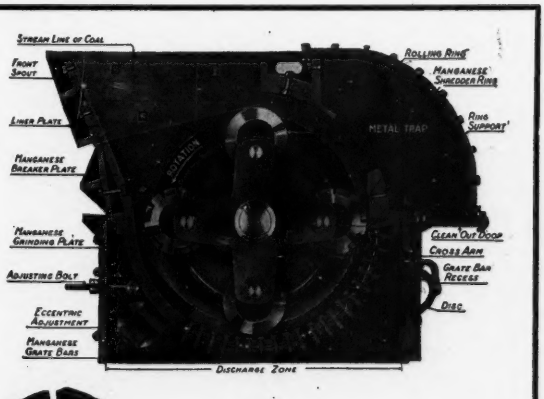
Properties and Applications of Phase-Shifted Rectified Sine Waves. By J. Tykocinski Tykociner and Louis R. Bloom. Size 6 by 9 in., 54 p.; paper bound. Published as Bulletin Series No. 339 by the Engineering Experi-

COAL IS AMMUNITION FOR WARTIME PRODUCTION — USE IT WISELY

SIZE IT FOR SAVINGS

The "AMERICAN" CRUSHER WAY

ONE of the many progressive stations taking advantage of better coal sizing to improve boiler performance and effect worth-while savings is the plant of the Central Illinois Light Co., Peoria, Ill., as illustrated at the right.



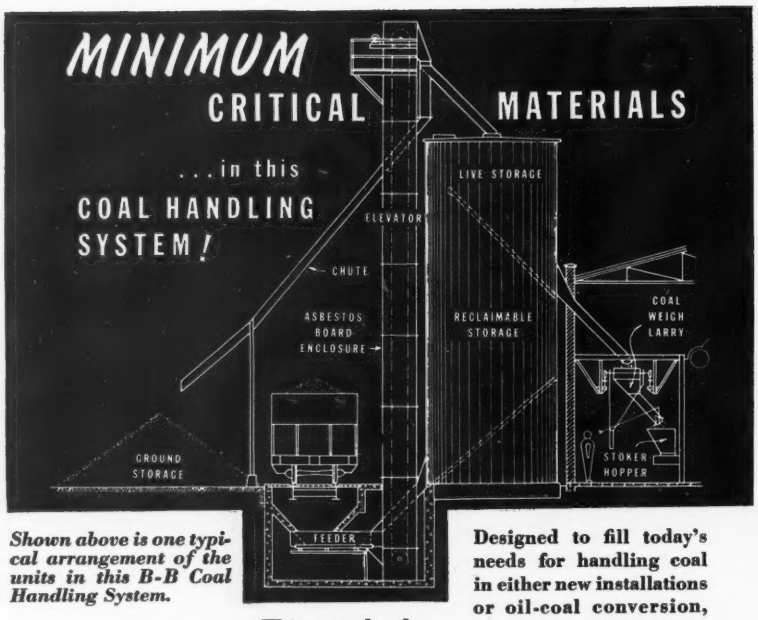
Above: Cross-sectional view of American Ring Crusher. Left: Patent shredder rings split coal in uniform size instead of crushing it —a patented "American" feature.

Here, a Type S AMERICAN RING CRUSHER reduces coal from run of mine to screenings—properly sizes it at the rate of 125 tons per hour, eight hours per day.

In many plants, large and small, fuel savings from 2½ to 8 per cent are being reported and total crushing costs (including fixed charges) kept to less than 2 cents a ton through the installation of "AMERICANS."

You, too, have a splendid opportunity to step up boiler performance and step down costs through better coal sizing the AMERICAN Crusher Way. Complete crusher information, including names and addresses of users, will be forwarded on request.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS



Shown above is one typical arrangement of the units in this B-B Coal Handling System.

Write us today for complete details.

Designed to fill today's needs for handling coal in either new installations or oil-coal conversion, this system offers numerous advantages. Send for full information.

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MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

IF YOU S-L-O-W DOWN YOUR PUMP SPEED—

WILL YOU SAVE STEAM?

"YES, indeed," say the scores of engineers who have installed COMBINATION Pump Valves. These improved non-tilting valves close quickly, enable the pump to handle its theoretical capacity without racing and thus wasting costly steam. Then, too, their extra durable construction (seat, stud and spring are Phosphor Bronze) means fewer pump shutdowns for overhauling, real savings in maintenance.

Many plants report that the steam and replacement savings of COMBINATION Pump Valves repay their cost in six months' time. They match the splendid trouble-free performance assured also by COMBINATION Silent Check Valves.

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BOILER FEED
VACUUM
CONDENSER
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GENERAL USE
Pumps

We Make Immediate Deliveries
Best of all, you don't need to wait to give your pump jobs the increased efficiency COMBINATION non-tilting Valves guarantee. Provided a reasonably good priority rating is shown, we can make immediate deliveries. Write us today for further information.

COMBINATION PUMP VALVE CO.
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ment Station of the University of Illinois, Urbana, Ill. Price 60 ct.

This is a report on an investigation being carried on in the field of rectified phase-shifted sine waves to analyze by graphical methods the properties of wave forms obtained by subtraction or addition of two phase-shifted rectified sine pulses; to show that new wave forms are also obtainable by subtraction or addition of a full sine wave and a phase-shifted rectified sine pulse; to verify experimentally the predicted properties and to illustrate them by oscillograms; to develop means of producing phase-shifted rectified sine waves whose phase angles can be precisely adjusted; to substantiate the graphical method by a mathematical discussion of the new wave forms; and to devise means for the applications of the properties of the new wave forms.

Influence Charts for Computation of Stresses in Elastic Foundations. By Nathan M. Newmark. Size 6 by 9 in., 28 p., with three charts enclosed in a pocket pasted on the inside back cover; paper bound. Published as Bulletin Series No. 338 by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price 35 ct.

This bulletin describes a simple graphical procedure for computing stresses in the interior of an elastic homogeneous, isotropic solid bounded by a plane horizontal surface and loaded by distributed vertical loads at the surfaces. The stresses are computed from the charts enclosed with the book merely by counting on a chart the number of elements of area, or blocks, covered by a plan of the loaded area drawn to proper scale and laid upon the chart. The use of influence charts is simple and rapid, and the accuracy of the calculations is sufficient for all practical purposes.

FOR THE ENGINEER'S LIBRARY

Coupon for obtaining free literature listed here may be found on page 164, under the heading Helpful Bulletins.

Electrical Equipment

1 Switchgear—Switchgear for mercury-arc rectifier equipment is illustrated and described in 18-p. bulletin GEA-3898. Included are installation diagrams and dimensions. General Electric Co.

2 Transformers—Power and distribution transformers and other electrical distribution equipment important in maintaining an efficient flow of power to vital war industries are completely described in a new 20-p. bulletin B-6186. Important wartime considerations such as the use of modern welded construction and standardization of design in order to save vital materials and provide interchangeability in installation are discussed. Allis-Chalmers.

SAVE . . . good tubes . . . precious copper . . . double outages . . . priority hang-ups . . . contamination of feed

THE good tubes stand up under shock test for double service life; weak tubes are replaced on the first outage. Copper waste and priority hang-ups are eliminated by Conseco reconditioning of the tubes you've got. Without shutdown, "Wizard" Injectors stop tube leaks, protect condensate.

TUBES can be protected . . . tested . . . stretched . . . made to last. *Protected* from corrosive air and the wear of circulating water by Air & Erosion Eliminators. Or by the sleeve-type protection of FLOWRITES. *Tested* by hydrodynamic shock to destruction of bad tubes. Conseco *stretched,* cut off and used again.

YOU'VE GOT help available, quickly. That help is geared to act quickly. Skilled crews. Portable shock-test and tube-stretching equipment. Semi-Finished Air & Erosion Eliminators in stock. FLOWRITES and "Wizard" Injectors in stock for immediate shipment. If you have normal Power Plant priorities, your job, anywhere in the United States and adjoining territory, can be booked on a clock-around schedule to completion.

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SEABOARD BANK BUILDING — HOBOKEN, NEW JERSEY

An Easy Way To Make a Brick Refractory Lining Last Longer...

An application of Brickseal, a semi-plastic, highly glazed, monolithic coating, prevents brick refractory linings from developing minute cracks or fissures in brick joints when forced to undergo rapid changes in temperature. Once on, Brickseal will not crack, peel, bloat, or blister and . . . fuel oil or combustion gases do not impair it. Brickseal also rebinds brick already cracked or loosened.

BRICKSEAL REFRACTORY CO.
1029 CLINTON ST.
HOBOKEN, N. J.

3 Transformers — Dry-type transformers for power and lighting circuits of 600 v. and below are described in detail in Bulletin GEA-897-J. Included are tables of ratings, list prices and dimensions, photographs, outlines and dimensions, and wiring diagrams. General Electric Co.

4 Lightning Protection — Lightning protective equipment for a.c. rotating machines and a.c. side of rectifier equipment is described in Bulletin GEA-1743-E. The bulletin contains drawings of typical schemes of protection for various connections, list prices, tables of capacities, photographs and drawings of the equipment. General Electric Co.

5 Porcelain Insulators—A new general catalog covering standard insulators and hardware has recently been issued. It contains engineering outline drawings of the various insulators, clamps and hardware items shown with dimensions. Complete specifications are given for each. The bare wire table for all types of line in general use is given, also a complete list of insulator equivalents. Porcelain Insulator Corp.

Instruments and Controls

6 Reducing Fuel Consumption — A new 12-p. Manual of Temperature Regulation, illustrated with charts and diagrams, discusses how buildings can save the maximum amount of fuel by keeping inside temperatures at a fixed level. Construction, application and operation of the Tri-trol Regulator are described in detail. Marsh Tri-trol Co.

7 Tachometers — Bulletin No. 790 describes the model J single-range hand tachometers. They are of the centrifugal mechanical type and indicate speeds and changes of speeds of any revolving shaft or surface continuously and instantaneously. They are simple, accurate, and reliable instruments and are primarily designed for heavy duty service. The Herman H. Sticht Co.

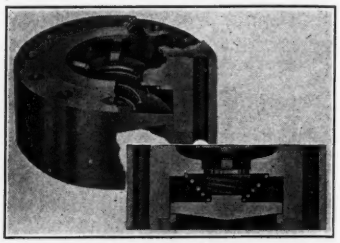
Pumps and Pressure Equipment

8 Safety Heads — A 28-p. catalog No. 42 illustrates and describes the B. S. & B. line of safety heads for pressure equipment. Included is information on the application of safety heads to various types of units, dimension tables, price list and advantages. Black, Sivals & Bryson, Inc.

9 Pumps and Compressors—Ro-Flo compressors and pumps of the sliding vane type are completely illustrated and described in a new 20-p. bulletin, B-6211. Motors may be directly connected to the Ro-Flo units. Also included are capacity tables and dimensions. Allis-Chalmers.

10 Centrifugal Pumps — Handbook for Wartime Care of Centrifugal Pumps is the title of a 27-p. maintenance guide which contains valuable wartime tips on the care of pumps. Included is information on easy ways to find leaks, common mistakes in packing stuffing boxes, how tight is "too tight" for a gland, how to figure head, how to

WILLIAMS-HAGER
Flanged Silent Check Valve



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- Works In Any Position
- Noiseless In Operation
- Protection Against Water Hammer

These improved side-guided check valves stay tight under every condition of service and pressure. Easily installed between flanges and readily removed for inspection. Sizes up to 20 in. and for pressures to 6,000 lb. They will handle all liquids, hot or cold—water, oil, gasoline, chemicals, etc. Get further details about this economical protection for pumps and service lines.

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WATER ANALYSIS
NOW MADE
Quick, Easy!

120 SECONDS OR LESS, NEEDED!

The new Taylor Water Analyzer is a sturdy outfit especially designed for speedy and accurate determination of the ammonia content and pH of condensate . . . the latter generally acknowledged as one of the most difficult of pH determinations. Now, you may easily determine both pH and ammonia content of condensate, as well as silica, total iron, etc., in boiler water by using the Taylor Water Analyzer. Entire operation takes only a few minutes! All color standards carry AN UNLIMITED GUARANTEE AGAINST FADING!

Complete with 1 slide, $18.00.
Extra slides, $8.00.
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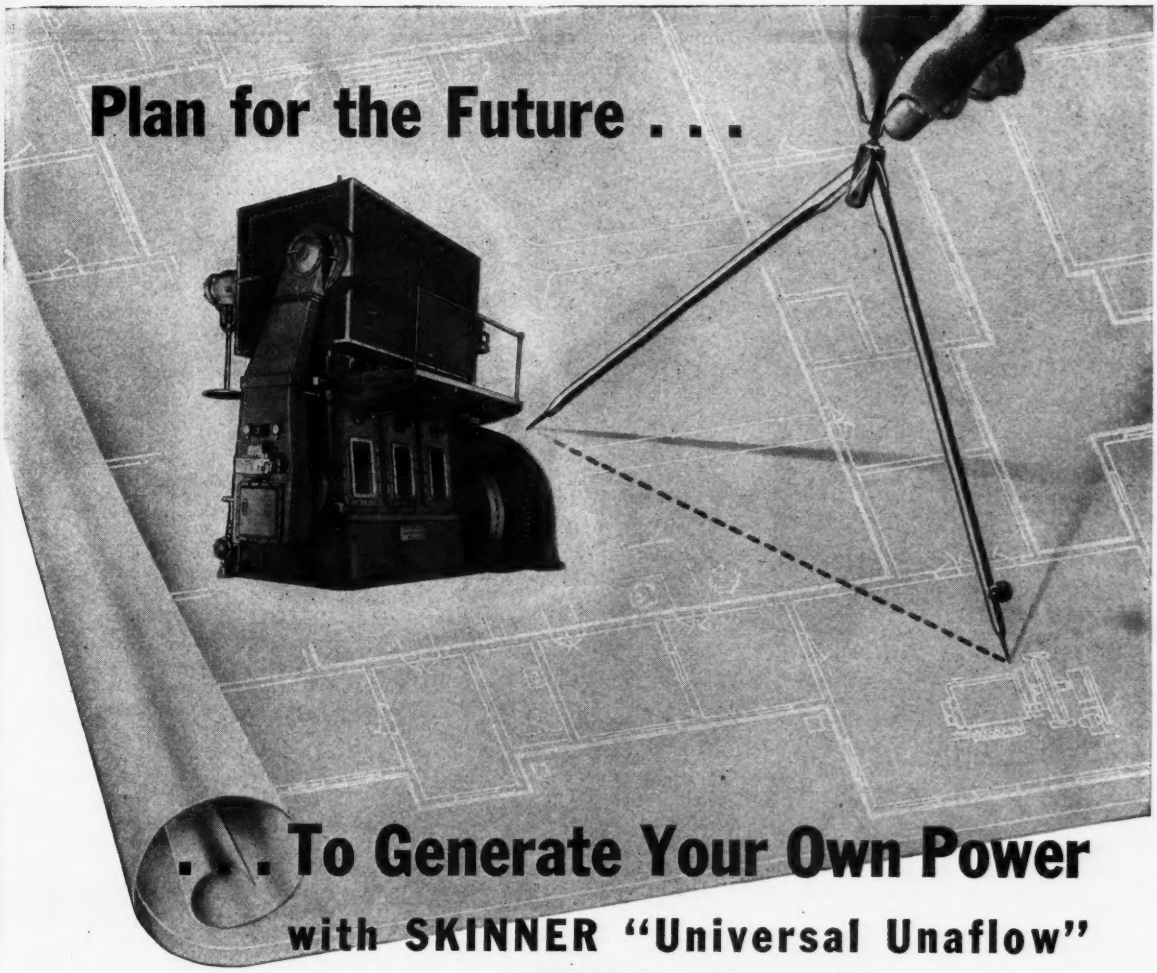

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INDUSTRIAL America is already looking forward to the day when our gigantic wartime plants will be restored to a peacetime basis. When that day arrives, vital materials now required by our armed forces will again be available for the production of consumer goods. Healthy competition in business will be resumed, and the manufacturer whose production costs are lower will have a definite advantage.

Plan now for the future—plan to effect savings in your power costs. In the past, many efficient power users, in varied industries, have found that in no other department of their business could savings be effected equal to those made by generating power in their own plants with Skinner "Universal Unaflow" Steam Engines and utilizing exhaust steam for heating and processing purposes.

Even though our production facilities are today devoted entirely to the building of Skinner Unaflow Steam Engines for the Army and Navy, our research and engineering departments are available now to discuss your plans for the future.

"The Most Economical Steam Engine Built"

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

STEAM* FLOW RATE IS EASY TO RECORD WITH SIMPLEX TYPE MS METERS

THE FLOAT MAKES THE DIFFERENCE!

The famous Ledoux bell-shaped float used in Simplex MS meters, automatically extracts the square root of the law of flow. As a result the float moves in direct proportion to the rate of flow.

WHAT DOES THIS MEAN TO YOU?

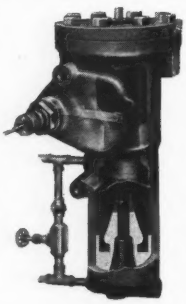
1—Evenly spaced charts—easy reading at both low and high rates.

2—A continuous type integrator—eliminating intermittent integrator movement.

3—Accuracy—the float directly connects to the pen arm which assures consistently high accuracy at low, intermediate, and high rates of flow.

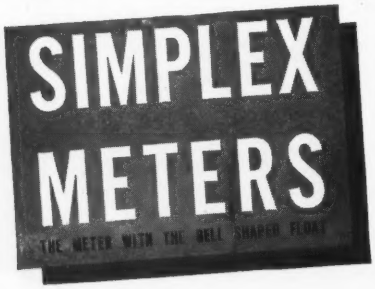
4—Elimination of friction producing cams and levers (it floats in water on mercury).

5—The precision machined hard rubber float is not affected by changes in temperature, nor by the type of liquid.



Movement of this specially designed float is caused by differential pressure from high and low pressure taps at Orifice plate, flow nozzle or Venturi tube. Write today for further information.

SIMPLEX VALVE & METER CO.
6783 UPLAND ST. PHILA., PA.
*Boiler feed, condensate, gas, air, water, etc.



protect pumps against cavitation, the vital role of water as a lubricant in pumps, quick diagnosis of pump ills, and many others. The manual applies to all makes of pumps. Allis-Chalmers.

Water Treatment

11 **Water Treatment**—Ion exchangers for industrial processes is the subject of a recent bulletin describing developments of acid-regenerated cation exchangers and anion exchangers which have greatly widened the field of water treatment. The chemistry of the process is also outlined. The Permutit Co.

12 **Feedwater Test Kit** — Bulletin W-210-B28 illustrates and describes the Dissolved Oxygen Test Kit Type O-1 for accurate determination of the dissolved oxygen content of deaerated boiler feedwater. Worthington Pump & Machinery Corp.

Wartime Maintenance

13 **Roof Ventilators**—Bulletin 217, an 8-p. catalog, describes a new line of roof ventilators made of non-critical materials. Various ventilator designs are patterned after the original metal Swartwout Ventilators and are for use in essential applications where metal is not vitally necessary. The Swartwout Co.

14 **Bearings**—A new 15-p. illustrated bulletin in color, explains the manufacturing procedure in renewing worn ball bearings in order to make them last as long as possible during the war emergency. Ahlberg Bearing Co.

Help Wanted

WANTED

Process engineers (junior) to do general trouble shooting and help improve process of manufacture of small arms munitions. Applicants should have college training in science plus some experience in industry and mechanical arts. Should not be immediately subject to draft and preferably under 30. Location, Midwest. Address Box 1414, Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

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SALES REPRESENTATIVES WANTED

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gives a
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pressure
DE LAVAL-IMO
The discharge from a De Laval-IMO rotary displacement oil pump is smooth and free of pulsation. Where the pump serves fuel oil burners, this is conducive to a steady flame and more efficient combustion. The unit shown, which is to supply burners in marine boiler furnaces, is designed for vertical mounting on a bulkhead. The IMO pump has neither valves nor gears, and no reciprocating or unbalanced parts. The interior is easily accessible.
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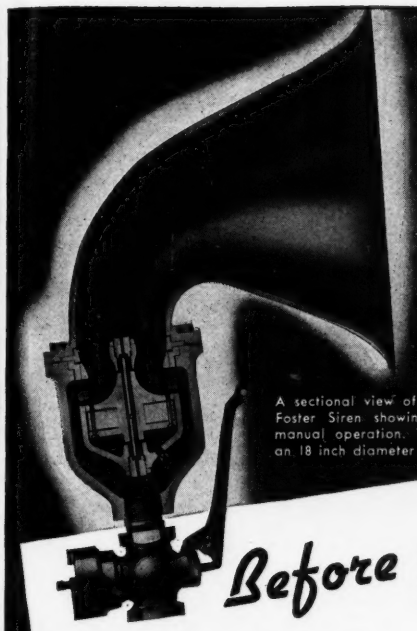
IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

Is your air-raid warning system adequate?



A sectional view of the Type 45 Foster Siren showing valve for manual operation. This size has an 18 inch diameter horn.

Before you order additional sirens . . . Check these points

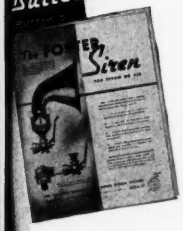
1 Are they available now?

We have a supply of Foster Sirens *in stock*. And—as they are manufactured of fewer non-critical materials than many other sirens, a correspondingly lower priority is required.

2 Are they sufficiently audible?

The Foster Siren has one of the widest ranges of audibility—one of the highest decibel ratings. The Type 45, for example, produces a sound level of 125 to 130 decibels at 100 feet—and is non-directional.

Send for Bulletin 29



3 Are they adaptable to existing conditions?

This siren may be manually operated, or you can add a solenoid valve for electric remote control . . . either for separate push-button operation, or tied in as an integral part of an air-raid warning, fire-alarm or other signal or coding system.

4 Are they expensive?

On the basis of "dollars per decibel", the Foster Siren is lower in price than any siren manufactured, according to the latest figures available. The initial cost is not only low, but installation costs are far below those of sirens of comparable audibility.

FOSTER ENGINEERING Company

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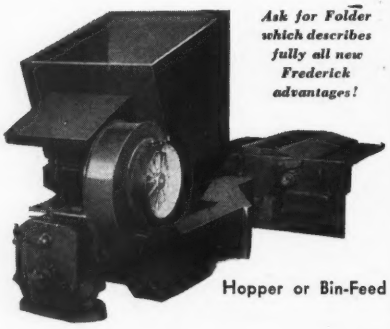
A famous stoker, newly re-designed for added thrift, convenience and efficiency, . . . ready for

FUEL OIL BURNER CONVERSION JOBS

Many important new features that solve common stoker problems!



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Hopper or Bin-Feed

FULL ACTIVE GRATE SURFACE

That's one important Frederick advantage! *There's more grate area—with low combustion rate per square foot!* . . . Frederick Stokers have fully active, self-contained burning ends, with specially designed, heavy-ribbed tuyeres, and with air ports so arranged and proportioned as to insure correct air distribution and maximum efficiency in combustion!

Just one of many new developments, Frederick engineered, this new burning end and other Frederick developments for increased stoker efficiency, convenience and economy are described fully in folder free upon request. Write for your copy—today.

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The FREDERICK IRON & STEEL CO.
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Also makers of a Complete Line of Centrifugal Pumps for all purposes • Steam operated Ash Conveying Systems • and Ash Storage Bins

15 **Fluorescent Maintenance**—How to care for your fluorescent installation properly and get maximum lighting service from it is the subject of a new booklet, entitled Timely Wartime Tips on Fluorescent Maintenance. The booklet outlines the setting up of a regular maintenance routine, tells how to determine the frequency of a regular cleaning schedule, how to figure the number of lamp replacements per month. It also gives many other valuable suggestions to keep fluorescent installations operating at peak efficiency. Sylvania Electric Products, Inc., Lighting Division.

16 **Plastic Insulating Coating**—A new 32-p. "NoDrip" Handbook explains how to prevent and cure damaging condensation and sweat that forms on metal pipes and fixtures, on walls, ceilings, etc. Included in the booklet are complete price lists. J. W. Mortell Co.

Lubrication

17 **Industrial Lubrication**—The Alemite Lubrikart, a portable power lubrication machine, is illustrated and described in a new leaflet, Form 22-62. Included are photographs of the two models available, together with a table of specifications. Alemite Division, Stewart-Warner Corp.

18 **Oil Seals**—New Data on Oilseals and Greaseals is the title of a new bulletin which presents the latest detailed information, recommendations applications, diagrams, listings, prices, etc., on the broad line of Gits Oilseals and Greaseals. Gits Bros. Mfg. Co.

Safety Equipment

19 **Industrial Safety Equipment**—Everything for safety is the theme of a 134-p. catalog which illustrates and describes protective equipment for all types of industrial work. Included are goggles and face shields, welding accessories, respirators, gas indicators, safety belts, various types of protective aprons, overalls and leather mittens, fire fighting equipment, rubber clothing, industrial footgear, safety matting, first aid kits and accessories, etc. The Boyer-Campbell Co.

20 **Welding**—Arc Welding Accessories for Women is the title of an attractive new bulletin GEA-3295 which presents General Electric's complete line of safety clothing and equipment especially designed for the country's steadily increasing army of girl welding operators.

Among the items illustrated and described are tailored leather welding jackets, sleeves, aprons, and gloves; flameproofed duck aprons and sleevelets; and a special flameproofed hat designed by Sally Victor for General Electric to protect the hair from sparks and flying slag. This hat can be worn under any standard welding helmet. Also featured in the bulletin are protective goggles, ventilated handshields, and plain and flip-front ventilated welding helmets. General Electric Co.

Miscellaneous

21 **Spreader Stokers**—Bulletin No. 78 describes the Fyr-Feeder multiple spreader type stoker under the theme "burns coal like oil." The principle of the multiple spreader stoker is included with detailed illustrations and installations. American Coal Burner Co.

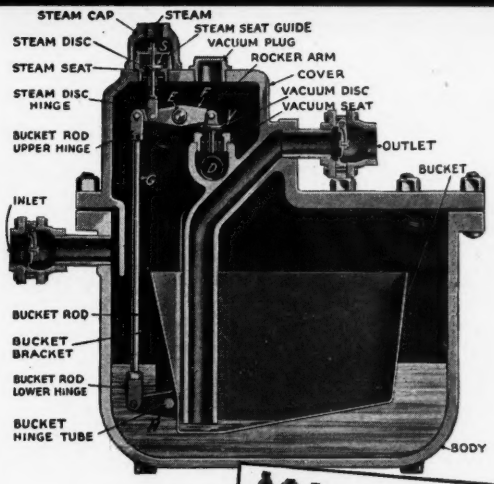
22 **Rubber Goods**—To aid industrial engineers, designers, plant superintendents and purchasing agents, an 8-p. catalog section on the subject of industrial rubber goods has been announced. It is in question and answer form, and designed to supply practical information for those who need guidance in the use, application and development of rubber parts molded to fit specific industrial requirements. The B. F. Goodrich Co.

23 **Mechanized Sweepers**—Two new catalogs describe three models of Moto Sweepers. Two of the "sweeping crew" on wheels are motorized and have optional sulky equipment for the plants of great expanse. The other is manually operated, pushes as easily as a broom and is said to clean as much as 16,000 sq. ft. of floor area per hr. The Moto-Mower Co.

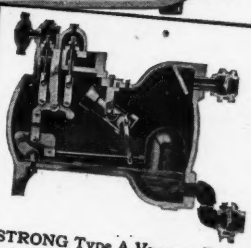
24 **Manganese Steel**—Manganese steel for the steel industry, considered the toughest steel known for blast furnace, coke plant, rolling mill and foundry equipment parts, is described in a well illustrated 47-p. bulletin No. 1142-SM. American Manganese Steel Division, American Brake Shoe & Foundry Co.

PIPEWRENCH PETE SAYS:

THIS TRAP MAKES LIQUIDS RUN UPHILL!



ABOVE: Strong Type M Trap removes liquids from a vacuum or low pressure and discharges to point higher than trap or against back pressure. Uses steam, air or gas only in equal volume to liquid removed.



STRONG Type A Vacuum Trap, primarily for atmospheric-gravity discharging. No steam required.

PLENTY OF SPECIAL FEATURES IN THESE POSITIVE-ACTING, TROUBLE-FREE TRAPS

It's no cinch to lick drainage problems like those you find in condensing engine exhaust lines, vacuum heaters, sump holes and the like. But STRONG has the right answer to all of 'em in these two traps for vacuum, lifting and pumping service—and built to handle water, oil or gasoline.

You'll find lots of smart engineering in 'em to help you do a better job and save the plant important money!

For complete details on this equipment, plus tips on making vacuum or lifting systems work better, get Catalog 64-PPE6 on STRONG Vacuum and Lifting Traps. No obligation, so drop a card now to . . .

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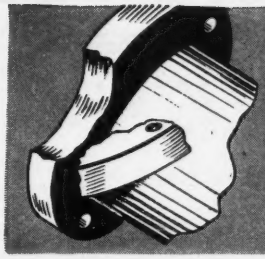

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Sometimes a piece of the flange on a connection to a condenser, heater, pump, etc., or on a pipe line may become broken off through bolt strain or driving a flat chisel in to open the joint.

When this occurs, a thoroughly practical and permanent repair can be made with SMOOTH-ON No. 1 without the use of heat or dismantling the apparatus. Paint a thin coat of SMOOTH-ON on both surfaces of the break, and join the broken part to the body of the flange. Then shrink an iron band around the circumference of the flange. If the break is across a bolt hole, an iron washer of large diameter may provide sufficient reinforcement for the repair.

SMOOTH-ON No. 1 is equally effective for sealing cracks in pump casings, heat exchanger shells, and other pressure vessel castings. Today, when new equipment is hard to get, and production delays cannot be tolerated, SMOOTH-ON is an indispensable necessity in every plant.

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for trouble-free valve jobs

In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent. . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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THE D. T. WILLIAMS VALVE CO.
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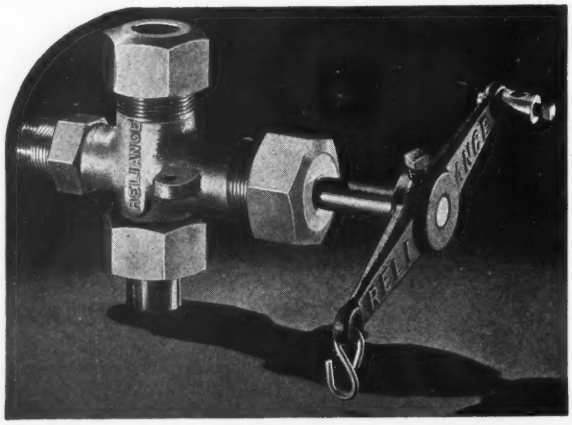

Reliance Gage Valves
help you prevent costly accidents and delays in vital production . . .

YOU CAN ALWAYS depend on quick-closing Reliance Gage Valves for unusually efficient "steam-proof" and "leak-tight" service. Features that assure long life and satisfying performance are loose monel discs, bronze seats, quadruple threads on stem for quarter turn action. Made for pressures to 250 lbs., and pressures to 450 lbs. Save you maintenance expense and annoyance. *Write for Bulletin 418 to The Reliance Gauge Column Company, 5902 Carnegie Avenue, Cleveland, Ohio*

Reliance Boiler Safety Devices since 1884

Special Request Bulletins

Welding—A 100-p. pocket size handbook entitled Welding and Brazing Alcoa Aluminum details the various types of welding including gas, arc and electric-resistance welding; and also includes information on inspection and specifications for gas and arc welding. The section on brazing deals with preparing materials for the process; furnace, torch and dip brazing; brazing castings, and cleaning joints after brazing. Included are illustrations of operations and equipment. Aluminum Co. of America, Pittsburgh, Pa.

Cranes and Hoists—Maintenance and Operation of Shepard Niles Electric Cranes and Hoists is the title of a handy 108-p. manual. The book includes general information on maintenance and operation, and detailed illustrations and descriptions of all equipment dealing with cranes and hoists. Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

Refractories—Continuing its program to speed up the wartime mine-to-metal cycle, the Bureau of Mines has published Information Circular 7227, Dolomite Base Refractories, describing recently developed methods for the manufacture of basic refractories used in steel-making from high-grade dolomite deposits found in several Eastern states, according to Dr. R. R. Sayers, Director of the Bureau. Successful commercial application of the processes would eliminate the necessity for expensive transportation of refractory magnesite from western states to the steel-producing centers of the East, the Director stated. The publication may be obtained without cost from the Bureau of Mines, Department of the Interior, Washington, D. C.

Civilian Defense—You and the War, a pamphlet to help civilians find their way into the war service and protective programs of their communities, was released by the Office of Civilian Defense in connection with the nation-wide campaign for volunteers. The 32-page illustrated publication, indexing more than 100 occupations and skills of particular value to civilian defense organizations, will be available through State and local Defense Councils, regional offices of the OCD and more than 300 national magazines.

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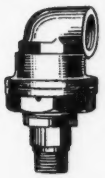

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The single gasket in each joint is quickly replaceable without disconnection of section.

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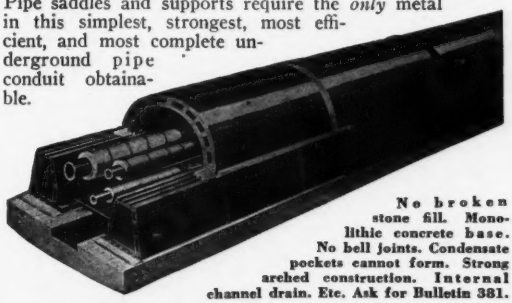
Reg. U. S. Pat. Off.

Underground Pipe Conduit

You SAVE METAL when you specify THERM-O-TILE. By saving metal you HELP WIN THE WAR. Pipe saddles and supports require the *only* metal in this simplest, strongest, most efficient, and most complete underground pipe conduit obtainable.



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Clip your name, firm, and address to this ad; tear out with the checked squares above, mail, and you will hear from us promptly.

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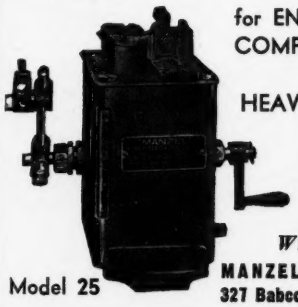
provide POSITIVE, AUTOMATIC LUBRICATION



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MANZELS always deliver exactly the right amount of oil at exactly the right time.

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Model 25

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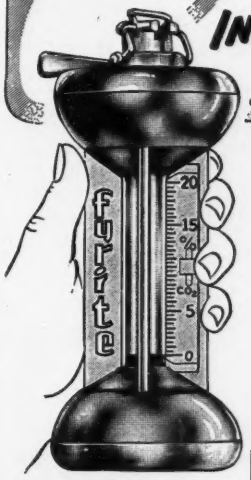
PORTABLE FYRITE "ORSAT" CO_2 Analyzer

INSTANTLY EXPOSES FUEL WASTE!



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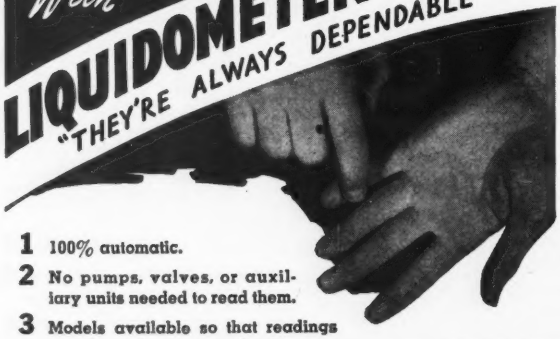
5 Reasons Why We Measure Our Valuable Stored Liquids With **LIQUIDOMETER** *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"



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3. Models available so that readings can be taken remotely from or directly at the tank.
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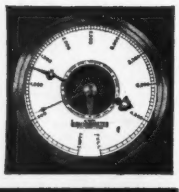

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Power Plant Construction News

Fla., Lynn Haven—U. S. Engineer Office, Jacksonville, Fla., plans new bulk oil terminal on waterfront at Lynn Haven, equipped for capacity for handling about 50,000 bbl. of fuel oil per day. Installation will include pumping machinery and accessories, special steam plants with movable coils for heating oil for pumping from barges, battery of steel storage tanks, pipe lines and other facilities. Cost estimated close to $5,000,000. Work is scheduled to begin soon.

Ill., Chicago—American Phenolic Corp., 1830 South Fifty-fourth Ave., Cicero, Chicago, manufacturer of plastic products, plans installation of electric power equipment in new addition to plant, about 250 000 sq. ft. of floor space, reported to cost over $600,000. Burnham & Hammond, 160 North La Salle St., Chicago, are architects.

Ill., Rock Island—Rock Island Sash & Door Works, Rock Island, plans installation of electric power equipment in connection with proposed rebuilding of plant, recently destroyed by fire with loss reported over $200 000.

Illinois—Republic Steel Corp., Republic Bldg., Cleveland, Ohio, plans installation of electric power equipment in connection with expansion in mill in Illinois (exact location not announced) for production for Government. Work will comprise a number of large buildings, equipped for extensive increase in production. Entire project will cost about $23,000,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be carried out soon.

Illinois—Studebaker Corp., South Bend, Ind., manufacturer of automobiles, now in production for Government, plans installation of electric power equipment in connection with expansion in plant in Illinois (exact location not announced), comprising several new units, equipped for large increased capacity. Entire project will represent investment of about $11,200,000, with financing provided by Defense Plant Corp., Washington, D. C.

Ind., Evansville—Schnake & Fawcett Co., 1307 First Ave., manufacturer of precision tools, plans installation of electric power equipment in new addition to plant, including alterations and improvements in existing structures. Cost estimated over $100,000. Walter C. Wagner, Breslin Bldg., is architect; and Warren & Ronald, Heyburn Bldg., mechanical engineers, both of Louisville, Ky.

Iowa, Sioux City—Sherman Preserving Co., Sioux City, manufacturer of food products, plans installation of electric power equipment in proposed new local dehydrating plant, comprising several large units, reported to cost over $200,000, including machinery. Work is scheduled to begin at early date.

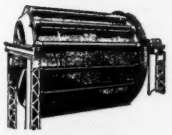
Ky., Bowling Green—Ken-Rad Tube & Lamp Co., Owensboro, Ky., manufacturer of radio tubes, electric lamps, etc., plans installation of electric power equipment in two new plants at Bowling Green, and Tell City, Ind., respectively. Each will comprise several large buildings, with boiler houses, power substation units and other facilities. Entire project will cost about $1,300,000, and will be financed by Defense Plant Corp., Washington, D. C., Federal agency. Work is scheduled to begin soon.

Ky., Louisville—Reynolds Metals Co., 311 West Broadway, Louisville, manufacturer of aluminum sheets, rods, alloys, etc., plans installation of electric power equipment in new addition to local aluminum extrusion plant. Cost estimated close to $1,500.000. Financing will be provided by Defense Plant Corp., Washington, D. C., Federal agency. Proposed to begin work soon. Joseph & Joseph, Breslin Bldg., Louisville, are architects.

La., Villee Platte—Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass., carbon black products, plans new carbon black plant in Evangeline County, near Villee Platte, comprising main extraction works, with compressor station, boiler house, pipe lines for natural gas transmission, control station and miscellaneous structures. Entire project is reported to cost over $150,000. Proposed to carry out work soon.

Mich., Dearborn—Ford Motor Co., Dearborn, plans installation of electric power equipment in new one-story addition to plant. Entire project is estimated to cost over

"PENNSYLVANIA" CRUSHERS



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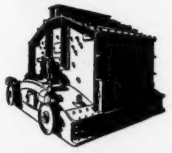

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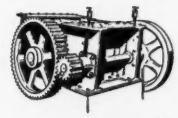

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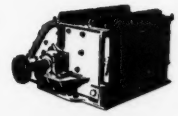

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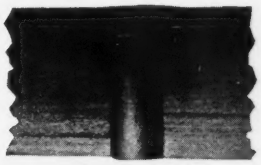

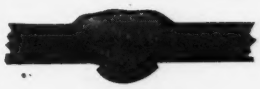

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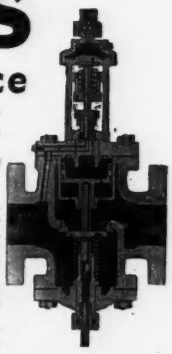

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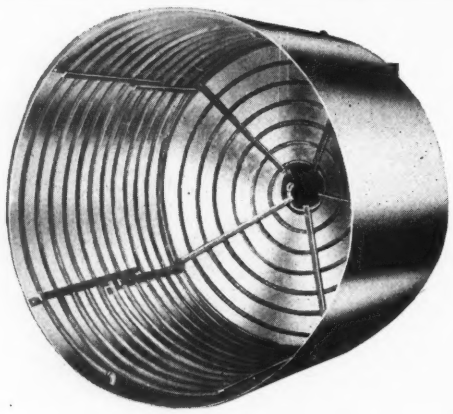

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$125,000. Work is scheduled to be carried out soon. Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., is architect.

Mich., Detroit—Briggs Mfg. Co., 11631 Mack Ave., Detroit, manufacturer of steel automobile bodies, now in production for Government, plans installation of electric power equipment in connection with expansion in plant, comprising several new buildings, equipped for large increased output. Entire project will cost about $700,000, financing to be provided by Defense Plant Corp., Washington, D. C., Federal agency. Work is scheduled to be carried out soon.

Minn., Fergus Falls—State Department of Administration, Capitol Building, St. Paul, plans installation of new boilers and auxiliary equipment in power house at State Hospital, Fergus Falls. Also will make extensions and improvements in central-heating system. Appropriations are being arranged.

Minn., St. Paul—Aluminum Co. of America, Inc., Gulf Bldg., Pittsburgh, Pa., plans installation of electric power equipment in connection with extensions and improvements in former plant of American Radiator Co., North Prior and Minnehaha Aves., St. Paul, recently taken over for new branch factory. Three one-story additions will be built, with largest, 60 by 345 ft. Conveyors and other mechanical-handling equipment will be installed. Entire project is reported to cost over $3,500,000. Work will be carried out at once.

Mo., Kansas City—National Distillers Products Corp., Peoria, Ill., operating local whiskey distillery, has acquired tract of about 15 acres of land in vicinity of Kansas City, for proposed new industrial alcohol plant for production for Government, recently referred to in these columns, and for which plans will be drawn by Sanderson & Porter, 52 William St., New York, N. Y., consulting engineer. It will comprise several large units, with boiler house and auxiliary structures. Electric power equipment will be installed. Cost estimated at $1,800,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency. Work will begin soon.

N. C., High Point—Federal Works Agency, Washington, D. C., has surveys under way for proposed hydroelectric power development on Yadkin River, initially begun as a municipal project by City of High Point and later taken over by Government. Work will include power dam, generating station with capacity in excess of 21,000-kw., water storage reservoir of about 15,000 acres of land, power substation and switching station, transmission lines and other accessory structures. Cost estimated close to $8,000,000. W. R. Holway & Associates, 302 East Eighteenth Street, Tulsa, Okla., are consulting engineers. Ward D. Carpenter, FWA, High Point, is project engineer.

Pa., Philadelphia—International Resistance Co., 401 North Broad St., Philadelphia, manufacturer of resistors, resistance indicators and allied apparatus, plans installation of electric power equipment in connection with expansion in plant for production for Government, comprising several new units. Entire project will cost about $2,000,000 and will be financed by Defense Plant Corp., Washington, D. C., Federal agency.

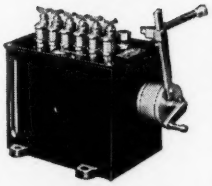
Pa., Philadelphia—Philadelphia Electric Co., Philadelphia, is providing appropriation of about $6,100,000 for expansion, improvements and maintenance in properties during 1943, including transmission and distributing lines, power substations, service connections and other facilities. Company has temporarily discontinued construction of new steam-electric generating station on Delaware River, on which work was begun a number of months ago, and will resume this project at a later date.

S. D., Vermillion—State Department of Education, Pierre, is considering extensions and improvements in power plant at State University at Vermillion, including installation of new generating unit and auxiliary equipment. No estimate of cost announced. Proposed to arrange appropriation in forthcoming budget to be presented to Legislature.

Pa., Buchanan—James River Hydrate Supply Co., Buchanan, plans installation of electric power equipment in connection with proposed rebuilding of hydrate lime plant, about two miles from city, recently destroyed by fire with loss reported over $150,000.

Wis., Waukesha—Alloy Products Corp., 241 Madison St., manufacturer of metal alloys, plans boiler house at proposed new one and two-story plant, about 120 by 300 ft., on local site. A power substation also will be installed. Entire project will cost over $125,000. Zagel, Sherman & Zagel, 424 East Wells St., Milwaukee, Wis., are architects.

BOWSER HELPS TO MAKE THE POWER NEEDED TO WIN "The war of Production"



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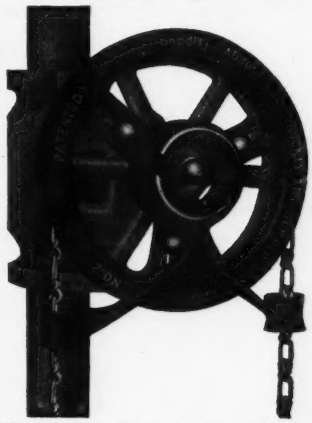

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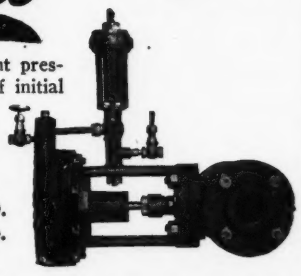

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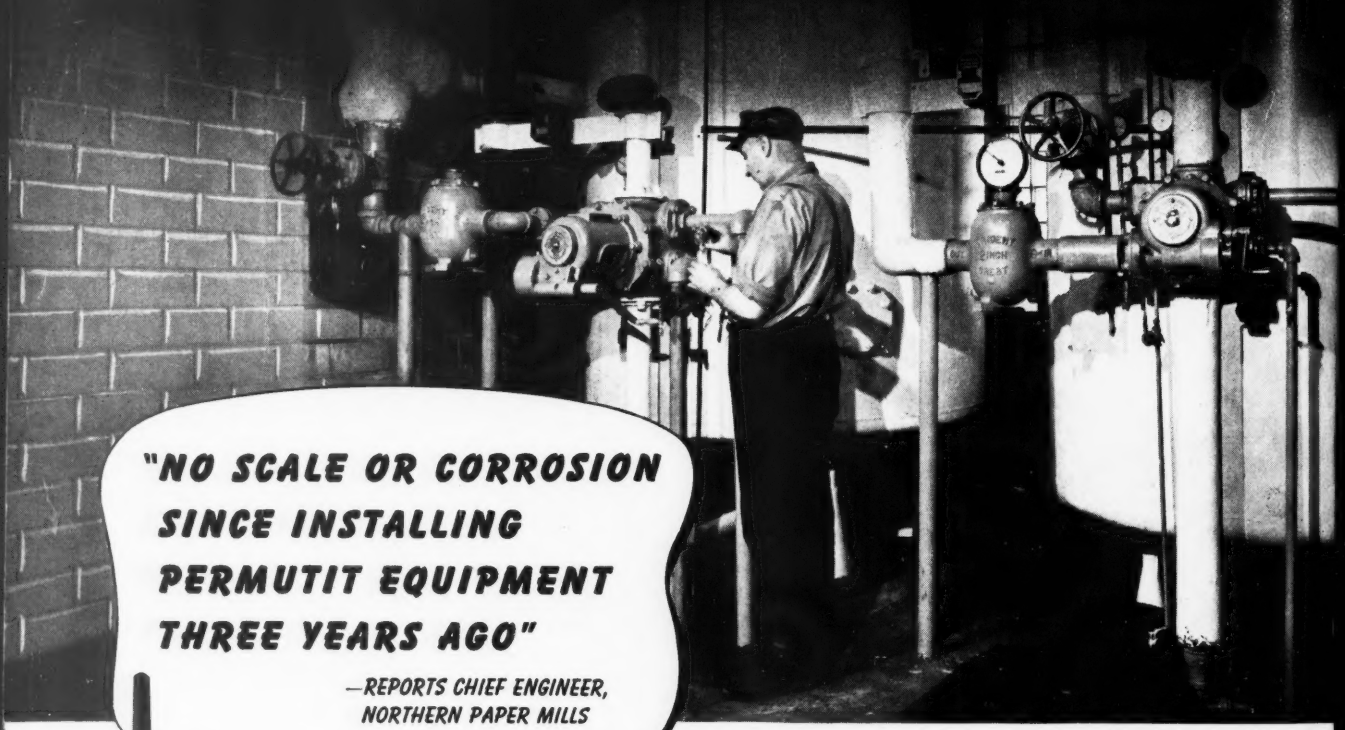
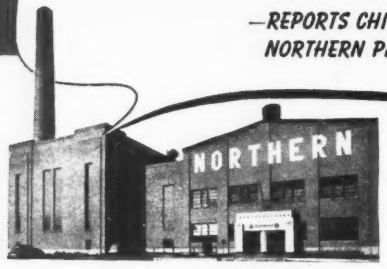
CHAPMAN NON-SLAM CUSHIONED CLOSING CHECK VALVES

GOOD WATER keeps boilers on the line 24 hours a day



"NO SCALE OR CORROSION SINCE INSTALLING PERMUTIT EQUIPMENT THREE YEARS AGO"

—REPORTS CHIEF ENGINEER, NORTHERN PAPER MILLS



Northern Paper Mills of Green Bay, Wisconsin, use large quantities of water for processing as well as for boiler-feed. They formerly obtained power from hydro-electric plants, but in 1938 decided to erect a modern steam plant. This has resulted in a constant flow of power to maintain 24-hour operation.

The new plant has a high pressure boiler operating at 650 pounds gauge and 700 degrees total temperature. Raw water, from a deep well, shows hardness of 240 ppm. Makeup is about 50 percent.

The exacting demands of the new boiler and the hardness of the water made modern water conditioning essential. So Permutit Zeo-Karb* H and Na Softeners (shown above) were installed, with a Permutit Deaerating Heater and a Permutit Condensate Filter.

Mr. H. W. Gochnauer, Chief Engineer, reports that the boilers, inspected every six months, show *no scale or corrosion.* Tests show continuous zero oxygen. Mr. Gochnauer expressed complete satisfaction with the equipment.

This example is typical of thousands of steam plants. Why not give *your* boilers this protection? The Permutit Company, Dept. A1, 330 West 42nd Street, New York, N. Y. In Canada: Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

*Trademark Reg. U. S. Pat. Off.

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SERVING INDUSTRY AND THE ARMED FORCES . . . WITH GOOD WATER